THE JOURNAL OF GAS LIGHTING
WATER SUPPLY & SANITARY IMPROVEMENT

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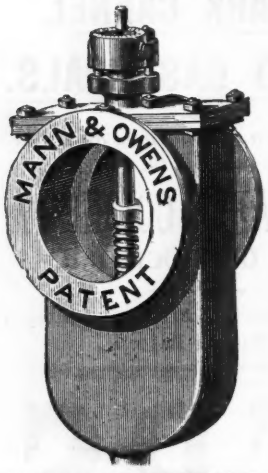

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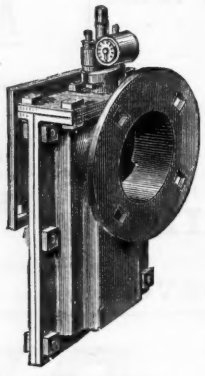

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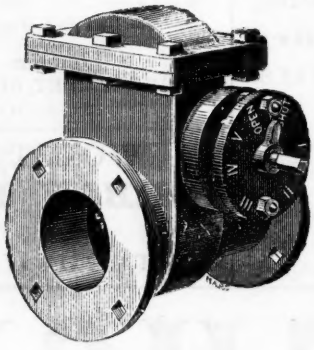

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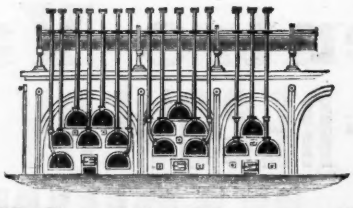

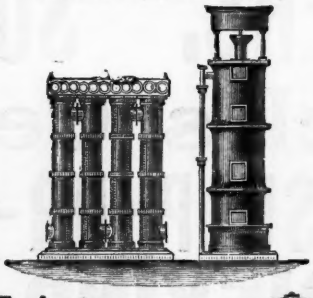

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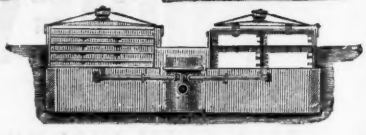

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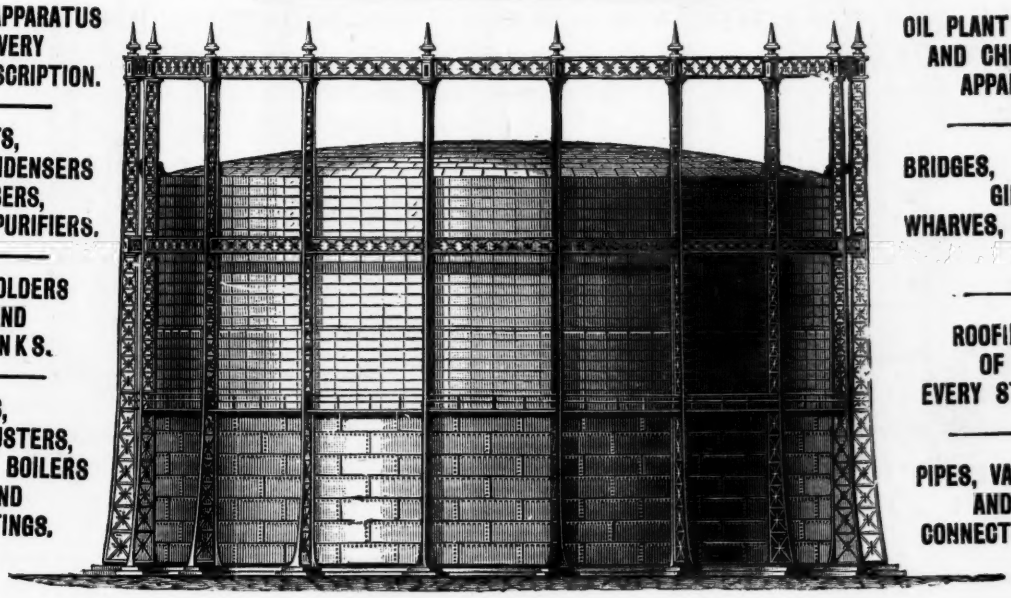

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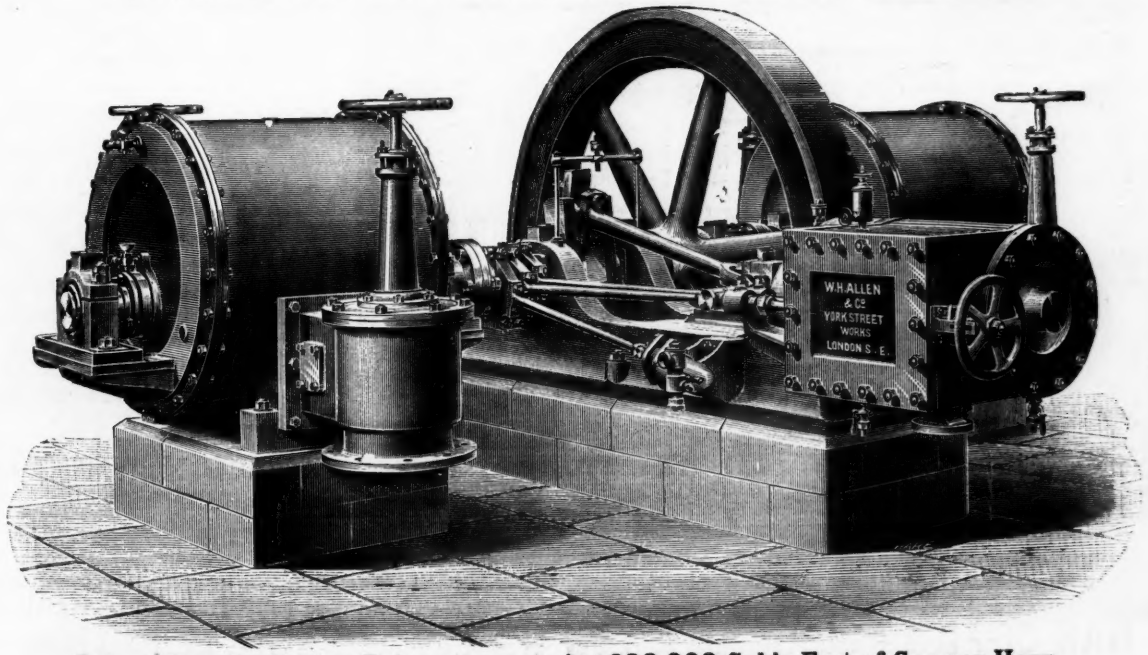

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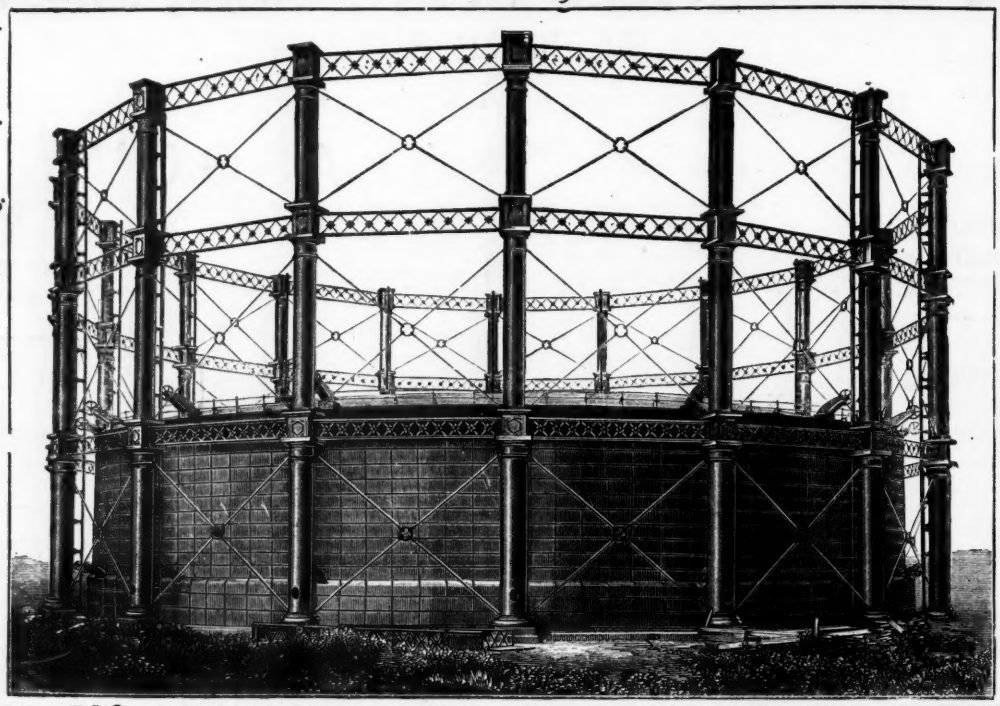

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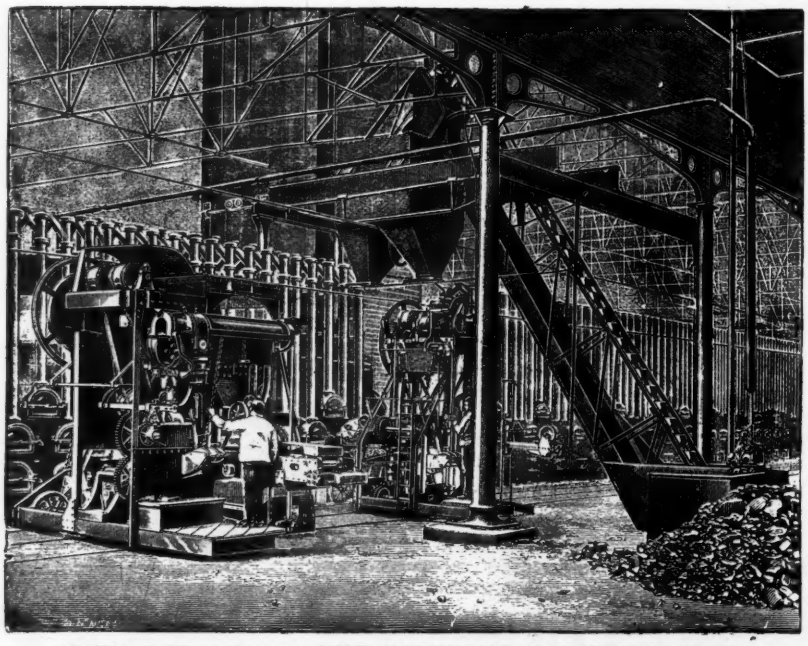

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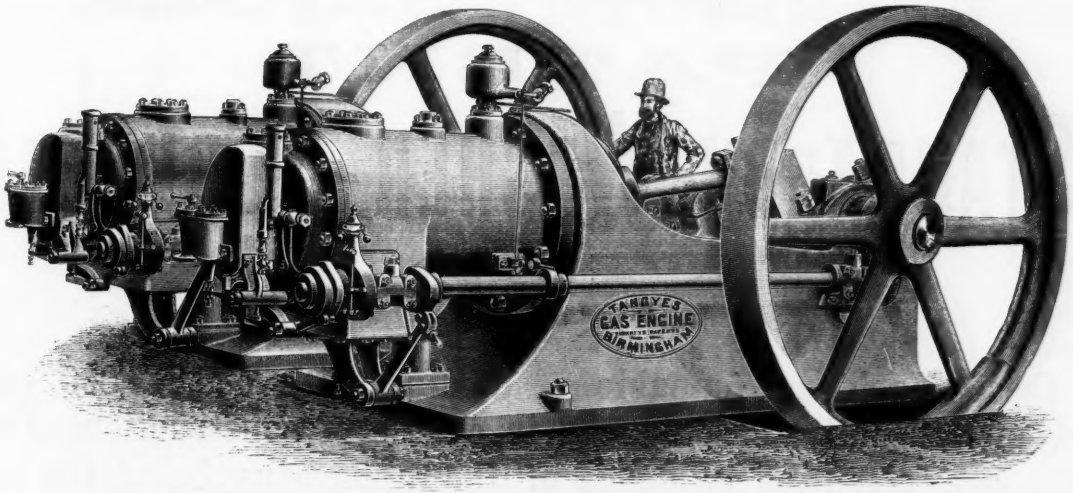

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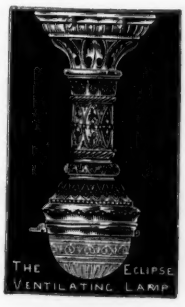

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456

of these Machines (capable of dealing with 436,345,000 cubic feet of Gas daily) erected and in course of construction. These facts are given as evidence of the apparatus being the most efficient of any in the market for the extraction of AMMONIA, CARBONIC ACID, AND SULPHURETTED HYDROGEN FROM COAL GAS.

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NOTE.—Orders since received for four 3,500,000 cubic feet per day Machines for Beckton; and two 3,000,000 cubic feet for Kensal Green, &c., &c.

Extract from the JOURNAL OF GAS LIGHTING, &c., for Sept. 27, 1892, referring to the visit of the Members of the Eastern Counties Gas Managers' Association to the Lowestoft Gas-Works—

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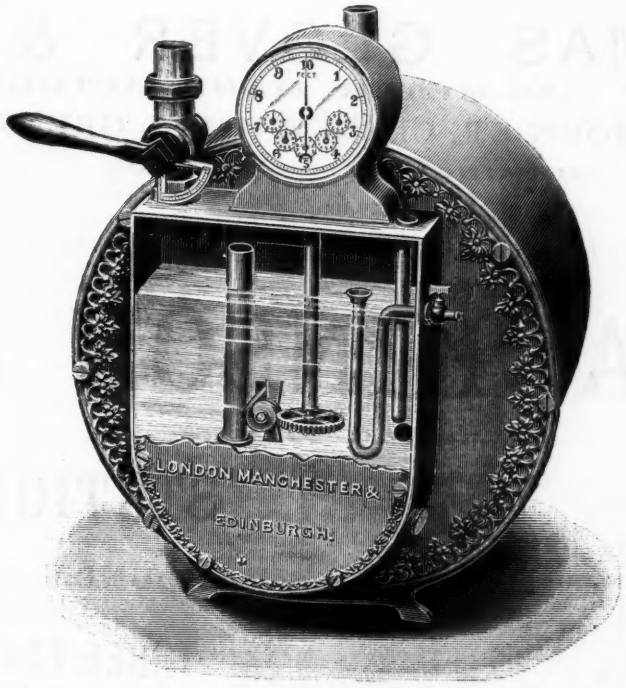

The Illustration shows a Meter specially designed for the purpose. The Case is Cast Iron; the Drum and Spout being of Tinned Copper.

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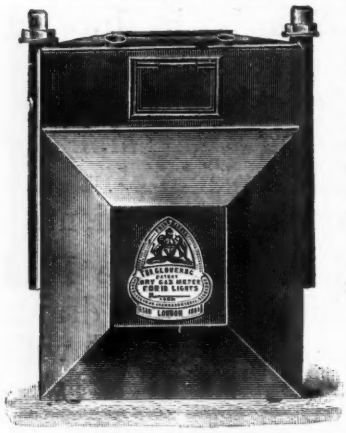

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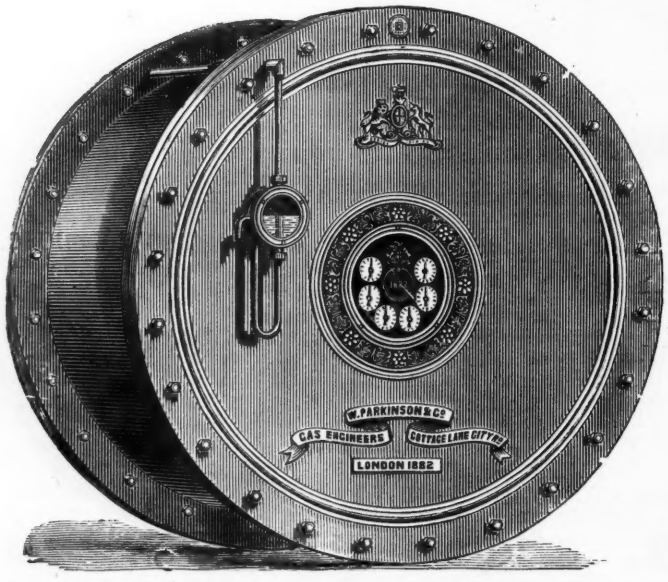

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[See also Advt., p. 1064.

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TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion must be authenticated by the name and address of the writer; not necessarily for publication, but as a proof of good faith.

THE

JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, DECEMBER 13, 1892.

The Interest of the Gas Industry in Currency Questions.

THE air has been thick during the past few weeks with rumours and discussions touching a variety of the important, but little understood subjects which underlie the structure of modern finance and industry. The erection of M'Kinleyism, which has dominated the fiscal policy of the United States, has suffered a damaging blow in the result of the recent Presidential Election; and in Europe the idea of bimetallism has appeared to gain in impressiveness. That the fancy for Protection has not quite died out from the minds of all classes of Englishmen was proved by the interesting, if abortive Congress of Agriculturists which met in London last week; and the question of the appreciation of gold has been seriously debated in several quarters. It may at first sight look as if we were going out of our way to mention such matters as the above in these columns; but it is easy to show that questions of currency, to name only one of the great problems that are just now being overhauled, possess a very particular interest for the followers of the universal industry of gas supply. English capital goes all over the world; and Englishmen go to look after it. It does not matter to English capitalists whether the currency of a country is of gold, silver, or leather; so long as it pays to deal with it, they will get up an exchange somehow. Thus it is we see the British sovereign turned into coins of all denominations and values known under the sun, and back again; and provided the double transaction leaves only a reasonable margin to the original possessor of the sovereign, he is content.

We cannot pretend to pronounce with any authority upon questions of currency or of international finance; but the existence of Gas Companies employing British capital in the supply of gas to communities for which the British sovereign is not the standard of value, is abundant reason why we should give heed to the existence of such questions, and incite our readers to study them. The interest of bimetallism, for instance, centres for us in the fact that much British gold has gone to build gas-works in countries where commodities are paid for in silver. When one has mentioned gold and silver, all the money there is in the world has been spoken of; for no nation values its commodities with reference to any other medium of exchange. There are gold countries and silver countries, and there are countries which refer indifferently to silver or gold; but it is impossible to get away from these two standards of value. Unfortunately, or fortunately—for these matters are so fiercely debated that it is impossible to be certain as to how the matter stands—the two universally used standards of value have no certain ratio to one another; so that it is not merely possible, but actually happens every day, that a commodity of intrinsic value, like wheat, may be reputed as worth one figure in a gold country, and quite a different figure may be quoted for it in a silver country. And what is true of wheat is, of course, true of gas.

The bimetallists assert that things would be very greatly benefited all round if the nations would agree to regard gold and silver as mutually convertible at a fixed ratio, so that it would not matter to anybody whether he received payment of his dividends, or for his commodities, in either medium. The difficulty here is that one medium of exchange would have to guarantee the stability of the other, to its own detriment. If silver cannot take care of itself, in the sense of maintaining its own value, say the monometallists, the result of putting the weak and the strong into double harness will only be that one member of the team will still continue to do all the work, and the risk of a breakdown will in nowise be diminished, but rather be increased. At present, the inconvenience of a silver standard is largely restricted to the country which harbours it; bimetallism would extend it to countries which now use only gold.

The question of the depreciation of silver comes out with special prominence in connection with the fortunes of such Gas Companies as the Oriental, or any one of the numerous South American undertakings which are financed from England. Take the example of any gas undertaking that has been established with the help of English gold for the supply of a silver-using people. The plant is purchased in England, and so is the coal from which the gas is made; and all the major expenses of administration are paid in gold. Yet the gas-rental is in silver, every exchange of which for remittance home is made at a greater loss than the last. Meanwhile, the consumers are unaware of any difference in the exchange value of their currency as compared with gold. The rupee and the silver dollar will buy as much of the necessaries of life in the local markets as ever; and the gas consumers would be justified in asking why these coins should not be as good for gas as for flour. Consequently, the Gas Company has to suffer.

It is argued that some of the results of the depreciation of silver are not bad for the silver-using countries. This line of considerations starts from the observation that, since it is only upon money exports that the loss by exchange falls, it is better to spend as much as possible in the country. If a British Indian Gas Company, for instance, could get native coal and iron instead of sending

home for these necessaries, so much more would be saved from the money-changers, and the local industries would also benefit. It is thus argued that Indian tea, wheat, and cotton owe their existence to the high value of the sovereign in rupees. It is at least certain that a local gas undertaking which would return a handsome dividend on local capital would show very differently if every item of expenditure and of interest payment were made upon a gold basis. Mr. H. D. Ellis tried to say something upon this head at the Oriental Gas Company's meeting a short time ago; but he was not very clear upon the subject of where British capital may expect most return—at home in gold, or abroad in silver. We should be glad to see this matter elucidated by those who are competent for the essay; but we have little hope that the hard problem of currency can be made simple. As to bimetallism for England, we have not the remotest expectation that it will ever be adopted, not merely because nobody appears to understand how it would work—for experience teaches that intelligibility is no bar to the popularity of a political cry—but rather because of the natural reluctance of the English people to tamper with the system of national finance that has carried British trade to its present volume with less disturbance, in the way of panics, than any other system can exhibit.

Dr. Gritton Apologizes.

The letter sent to us this week by the Rev. Dr. Gritton, the Secretary of the Lord's Day Observance Society, respecting his remarkable evidence before the Labour Commission as to Sunday work at the Leicester Corporation Gas-Works, is one of those epistles which no man ought to bring himself under the obligation of writing. It is a confession that the writer had allowed himself to get into such a state of mental confusion in regard to what he saw at Leicester, and what he was told somewhere else, that he misled the Commissioners, and everybody who, like ourselves and our readers, takes an intelligent interest in the condition of gas workers, into believing that Mr. Colson, the Gas Engineer to the Leicester Corporation, objects on principle to the Sunday rest which is part of the common law of England. We were obliged to report Dr. Gritton's evidence, which was naturally regarded as calling for some comment in these columns; and we are glad that the reserve we showed in accepting as true the strange statements of this doubtless well-meaning clergyman has been justified by the correction that he has now offered. It cannot be granted, however, that an apology for a misstatement is as satisfactory as its avoidance would have been. Unhappily, enthusiasts for a particular cause, among whom Dr. Gritton cannot object to being classed, have never been remarkable for prudence in making sure of the accuracy of their testimony; and thus many a good cause has been discredited in the eyes of fair-minded people. It is unnecessary to say more about Dr. Gritton, who, not being under any obligation to appear before the Labour Commission, must repent bitterly enough the exhibition he made of himself in his capacity of volunteer witness; for nothing that he said on this occasion can now have the slightest possible weight. There is a larger question growing out of this particular incident, reflecting upon the character of the whole inquiry in which the Labour Commission are at present engaged. How much of the evidence collected by the Commission is vitiated by the same blundering as that which has so promptly been brought to light in this case? Many of the witnesses have supported their statements by incontrovertible data; but much of the voluminous matter that will be contained in the printed proceedings of the Commission is not only *ex parte* evidence, but rests upon the uncorroborated word of notorious partisans. M. Renan, in one of his works, wisely remarks that history, which must necessarily be based upon data of varying degrees of trustworthiness, ought to be printed in characters similarly varying in depth of impression. By this device we should have in the same page statements printed in the deepest black ink, corresponding to absolute truth, mixed up with others of all shades between this and the lightest tint consistent with legibility. If such a process could be applied to the recorded transactions of the Labour Commission, a good deal of the printing would show but a thin body of pigment.

A French Gas Consumers' Congress.

It is an old French gibe at the English people, that we take our pleasures sadly; but we can return the compliment by pointing out that Frenchmen possess unequalled genius for treating trifles seriously. A good example of this is supplied by the recent Lyons congress of aggrieved gas consumers—surely one of the most ludicrously solemn farces that was ever played by unconscious humorists, who only become more amusing the more seriously they take themselves. We have already explained to our readers how certain citizens of Lyons, chafing under the yoke of the French concessionary Gas Companies, took the extraordinary step of inviting all fellow-sufferers to meet them in conclave in this city on the 27th ult., with the objects of making their common complaint heard, and concerting measures for obtaining relief. We have had gas consumers' agitations in England; but they have always been of a strictly sporadic character. The gas consumers of particular towns have protested time and again against the treatment meted—perhaps we ought to write metered—out to them by their local Gas Companies; but it can safely be said that it would never occur to a discontented gas consumer of (say) Falmouth, to convey himself as a "delegate" to Southampton, to compare notes of his woes with a *bourgeois* from Tyneside. However, they manage these things differently in France; and so we find at Lyons a M. Vignet presiding over a "scratch" assembly of sixty respectable French householders hailing from all parts of the country from Brest to Marseilles, from La Rochelle to Nancy, united for the nonce in raising the stirring *appel:* "Down with "the Gas Companies!" A glance over the credentials of these delegates gives one a deep impression of the completeness with which the French *bourgeoisie* appear to be organized for mutual protection. Here we read of the "League of Contributories" of Paris, the "Syndicate of "Suburban Traders," also of Paris, the "Syndicate of the "Hotel-Keepers of Le Puy," and similar associations, all organized at least to the point of sending a representative to Lyons, and paying the expenses, merely for the purpose of talking over the subject of gas supply. We have nothing like this unity of action, whether for good or bad. The proceedings began with a high-sounding declaration of the objects of the congress by the Secretary of the Organizing Committee (M. Pallière). "The congress," said this gentleman, "will occupy itself in seeing if the monopolists are "always to be masters, or if the concessionaires can be "made to bow before those who gave them their rights. "We shall hope to arrive at a practical solution, to the "destruction of monopoly. Let us discuss our interests, "and in this discussion the Parliament will find weapons "when the time of attack shall arrive. We may have to "come together again if monopoly persists; but let us "struggle boldly and unitedly, and we shall be con-"querors in the end!" Very tall talking, this, over a matter of gas supply; but it greatly pleased the meeting. There is nothing like doing things decently and in order; and therefore this astonishing assemblage constituted a "*bureau*" for the direction of its proceedings, named a pair of Secretaries, and divided itself into three Committees. It then adjourned. At the second sitting, a sheaf of recommendations from the Committees was produced, and these were discussed and voted upon with the happy knack of treating words as things which is such a marked characteristic of the French people. Was it not Louis Philippe's senators who met for the purpose of solemnly voting the perpetuity of the *régime*, and afterwards quietly left Paris to the revolutionaries? It would not have been natural for the second meeting of the congress to have finished without an "incident;" and so we learn that the Lyonnais and Marseillais delegates got to loggerheads over a suggestion of one of the former party that the price of electricity ought not to be higher than that of gas. At one moment everybody was speaking, and the tumult was extreme. Peace was eventually restored by somebody proposing a resolution which meant nothing, and consequently gave very general satisfaction. One gentleman, notwithstanding, "retired himself" from the scene; protesting against the attitude of the congress; whereupon the other delegates from the same region protested against his departure, and declared that they had no "solidarity" with the malcontent. All this is excellent fooling, so far as it goes; but our French contemporaries will find no difficulty in demonstrating that the gas industry is not to be played with according to the hare-brained notions of a handful of garrulous shopkeepers.

Another Meter Question.

The reputation of the consumer's gas-meter appears to be canvassed just now in other parts of the kingdom

besides the Lake district; the managers of a sectional exhibition recently held at the Agricultural Hall, Islington, having scattered broadcast, by means of a paragraph "communicated" to the Press, some injurious reflections upon the behaviour of certain meters used for registering the gas consumed in connection with this show. It is stated that seven gas-engines, each with its own meter attached, were exhibited in the hall during a period of ten days; and the total consumption of gas registered by these meters was 65,600 cubic feet. Meanwhile, however, the meter through which all the gas passed into the building, and by which the gas bill of the hall has to be made out, showed a consumption of 112,100 cubic feet. The story goes that the only other means of consuming gas operating at the particular time were "about 14 Bray's "No. 1 lights," which were alleged to have been used for only a "few hours." The promoters of the exhibition, probably having entered into an agreement with the exhibitors of the gas-engines for payment of the gas used for these machines, as registered by their separate meters, naturally enough wondered how the difference between these and the principal meter at the entrance of the hall could have arisen. They profess themselves unable to believe that the 14 Bray's lighting burners could have been responsible for the consumption of 46,500 cubic feet of gas during the 60 hours or so which is stated to be the whole time of their employment for the period covered by the exhibition; and they reject the suggestion that the suction-bags of the gas-engines could have drawn the gas through the small meters without its being registered. The idea of the possibility of leakage to the extent of the unaccounted-for consumption is also dismissed. The promoters of the exhibition express a wish to be enlightened on the matter. We notice the subject here for the guidance of all who may have the arrangement of gas-engine exhibits in the future. It first occurs to one that the Agricultural Hall people are going to the wrong place when they appeal to newspaper readers in general for information respecting a question of meter registration. Their proper course is to apply to the Gas Company, and then, if still dissatisfied, to have the principal meter tested. They probably do not seriously contend that their large meter is wrong; but they desire to know if the registration of the engine meters can have been right. On this point it might have been supposed that a very little explanation from an experienced meter inspector would suffice to prevent a matter of this kind from coming into the court of public opinion. There are conditions of the working of gas-engines when the registration of meters attached to them is seriously affected. Whether or not these conditions existed at the Agricultural Hall is more than we can say; but, unless good evidence can be brought forward in the opposite sense, we shall continue to believe that the principal meter was right.

Mr. W. A. Slack, formerly with the Windermere District Gas and Water Company, has been selected, out of 150 applicants, for the position of Manager of the "Victor" Engineering and Pulley Company, of Salford.

The Wenham Lamp Patents.—We are asked to mention that the action brought against the Lamp Manufacturing Company, Limited, by the Wenham Company, Limited, for infringement of their lamp patents, has been amicably settled.

Presentation to Mr. Peter Simpson.—Last Thursday evening, the employees at the Rugby Gas-Works presented their former Manager (Mr. Peter Simpson) with his portrait, together with an address, as a memento of his long connection with them, and of the respect in which they held him. The presentation was made by Mr. W. Batchelor, who has been in the Company's service nearly forty years.

The Managership of the Macclesfield Gas-Works.—Mr. J. G. Newbigging, son of Mr. T. Newbigging, C.E., of Manchester, has been appointed Engineer and Manager of the Macclesfield Corporation Gas-Works. There were 62 applicants for the post. Considerable extensions are now being carried out at the works under the supervision of Mr. Newbigging, who has for some time been Manager *pro tem.*

Death of Mr. J. G. Drew.—We regret to record the death of another official of the Oriental Gas Company—the Secretary, Mr. J. G. Drew. He entered the service of the Company as bookkeeper in 1869; and this position he occupied till the death of Mr. A. Hersee, the previous Secretary, in January last year, when he was promoted to the vacant post. He will be missed as an energetic servant of the Company, and by all those who were connected with him. He died last Friday, at the age of 49.

ESSAYS, COMMENTARIES, AND REVIEWS.

GAS AND WATER COMPANIES IN THE STOCK MARKET.

(For Stock and Share List, see p. 1053.)

THE past week brought some improvement into the state of things in the Stock Exchange. The general feeling was more tranquil—not so much because there was anything to detect by way of substantial amelioration in the outlook, as that a state of tension cannot be indefinitely prolonged. The disposition to be very cautious still prevailed, and hardly any business of a character at all speculative was done. One of the depressing factors of the previous week—the French Cabinet difficulty—had been removed; but another was accentuated, as the utter inability of the Brussels Congress to cope with the silver problem became more apparent. Artificial resolutions will never neutralize natural forces; and so long as the silver commodity is produced in quantities greater than the demand, so long will its value fall. But a ray of hope from the right quarter came on Saturday, in the shape of a telegram announcing that silver mines in Colorado and Montana would no longer pay at the price, and were shutting down. The Money Market remains the same, with every prospect of a continuation of ease. The Gas Market has been fully as active as might be expected. Changes in value are few and slight. But they are all in the upward direction; and the general tendency is towards firmness. A very favourable feature is the drawing in of the quotations of some of the leading issues to a narrower margin. This is the case in Gaslight "A," which has been pretty active all through the week, and as firm as a rock at 219-220—never going outside those limits. The demand for the gilt-edged securities has kept the debenture, preference, and limited issues in brisk action, and leaves them firm at the old figures. South Metropolitans were in great request; and an advance in the quotations could no longer be delayed. "B" stands out conspicuous at only a fraction over a level 5 per cent. price. The Company sold £25,000 of 5 per cent. debenture stock at the Mart on Friday, at an average price of about 142½—that is to say, they have borrowed £35,585 at 3½ per cent. interest in perpetuity, which is good business. Commercials were quiet and unchanged. There was rather more doing in the Suburban and Provincial undertakings; but no change occurred anywhere. Business was done at strong prices in the Continental Companies; buyers of Imperial offering 2 better, while other quotations held firm. The rest present no special feature; and their prices did not vary. Water was fairly active, and quotations moved up; Lambeth showing the way.

The daily operations were: Gas opened very strong; and the prices of everything touched were very good, but quotations were still left standing. The position was similar on Tuesday; Gaslight secured issues being specially in request. But still nothing would move except Imperial Continental, which rose 1. It was the same on Wednesday, though business was quieter; and Imperial Continental monopolized the advance with another rise of 1. Southwark Water went up 2. Business was quieter still on Thursday; but South Metropolitan "B" rose 1½, and ditto "C" 2. Prices of Gas remained very good on Friday, without further change. Lambeth Water 10 per cents. improved 2; and ditto debenture, 1. Saturday was firm and quiet all round; and the only change was a rise of ½ in Grand Junction.

ELECTRIC LIGHTING MEMORANDA.

The Gaslight and Coke Company and the Street Lighting of the City of London—The Report of the Electrical Standards Committee—The Economy of Breaking Lamps Betimes.

AN incident that cannot have been wholly unexpected marked last week's meeting of the City Commission of Sewers, when a letter read by the Engineer (Mr. W. Haywood, M.Inst.C.E.) brought up the subject of the relations between the Commission and The Gaslight and Coke Company with reference to the new electric lighting of the City streets. The Company have acted with exemplary patience during the whole of the protracted period during which the Commission has been playing with the electric light speculators; but matters came to a climax with the request of the Engineer that the Company should facilitate the utilization of the existing lamp-posts for incandescent lamps in such a way that, if the electric light should fail, the gas would still be available. To this modest request the Company replied with a temperate statement of the difficulties under which they have been placed in carrying on the street lighting. The particulars of this communication will be found in another column. It practically amounts to an *ultimatum* to the Commission to choose between electric lighting and gas; and it implies that the Company are not disposed to bear all the expense and risk of acting as a stand-by for the convenience of the electricians. Some Commissioners seem to think this declaration unkind on the Company's part; but street lighting is, after all, a matter of business, and it is hard to see why a Gas Company should lose money by it for the sake of other people. The Gaslight and Coke Company have made many attempts to improve the lighting of the streets of the City; but

not the slightest encouragement has been extended to them by the Corporation. The Company have had some amends for the lack of appreciation which they have endured in the City, in the triumph they have secured in the West; for it is acknowledged that gas more than holds its own in the lighting of Hyde Park Corner. So far as the City authorities are concerned, however, it is notorious that they have for years made the Company wait upon the electricians, and have stinted the gas lighting in order that the rival lights might show up the better in comparison. It is not to be wondered at if the Company have grown a little tired of the part that has been forced upon them in assisting the development of the business of the City of London Electric Lighting Company, which is a Mansion House pet.

It will be remembered that, speaking at the recent dinner of the Institution of Electrical Engineers, Mr. Mundella, M.P., the President of the Board of Trade, poked a little fun at the Electrical Standards Committee with reference to their recommendation of a quantitative expression for the alternating current. The report of this Committee has now been published. It aims at the establishment of new denominations of standards for the measurement of electricity, referable to the centimetre-gramme-second system, with a view to securing international agreement in this regard. The old names of the principal electrical units are retained; but their values are freshly defined. Only the ohm, ampère, and volt are taken into account as standard units; no mention being made of the multitudinous derived units with which some text-book writers have made such wild work. It is quite enough for most intellects to try and understand what is meant to be conveyed by the statement that an electrical pressure of one volt applied to a resistance of one ohm will give a current of one ampère. The curious thing about these new definitions of the electrical units is that the values are all fractional. Thus a mass of mercury of 14·4521 grammes at the temperature of melting ice, disposed as a column of constant cross sectional area, and 106·3 centimètres long, will give the resistance called an ohm. Of course, this is all right, or the eminent persons who have signed the report would not say so; but it is remarkable how science in this instance has shunned even numbers. The expressions relating to the measurement of the alternating current which so "gravelled" the President of the Board of Trade are doubtless as simple as could possibly be suggested with reference to their subject.

A curious article by M. Hospitalier has appeared in a French electrical journal (whence it has been copied into the *Electrician*), discussing the use of incandescent electric lamps from the consumer's standpoint. The result arrived at by the writer is the somewhat startling one that there is a period in the lifetime of every incandescent lamp when the user, if charged for current by meter, should, in his own interest, smash it, or at any rate remove it and return it to the maker, and obtain whatever may be the trade allowance for used lamps. This is no more than repeating the well-known truth that old lamps take more current than they give fair value for in light; but the picturesque way in which M. Hospitalier puts his advice to consumers is certain to draw renewed attention to the point. M. Hospitalier begins his article by remarking that, when incandescent electric lamps first came into commercial use, people were content to compute their value by their initial consumption of energy in watts per candle power, and by the average life guaranteed by the maker. This, we take leave to state, is precisely what our electrical partisans continue to do, when framing those imaginative estimates of the cost of electric lighting wherewith they gain over prospective clients who have no experience to guide them on this head. Unfortunately for the simple rule thus referred to by M. Hospitalier, the initial duty of incandescent lamps does not hold good for long; and to get a correct idea of the value of such lamps, we require to take into consideration the falling off in the candle power with time, the price of the lamp and its life, and the charge for electrical energy. Endeavouring to bring in all these factors in a rational manner, Mr. Edward O'Keenan has evolved an analytical method of arriving at the point when it is better to smash a lamp of any given make than to continue using it. In order to apply this method, as M. Hospitalier does to the hypothetical case of a Parisian consumer, it is necessary to know the character of the lamp in question—that is, how it stands in ordinary use. It is impossible to describe the operation without the necessary diagrams, which must be drawn with reference to data prevailing in the particular instance; but it must suffice here to say that the method recommended by M. Hospitalier shows the moment in the life of a lamp at which a given quantity of light has been obtained for a minimum price. This is the signal for dispensing with its further services. The conclusion that stands out more clearly after a study of these diagrams is that the smashing-point is reached before the nominal life of the lamp has run; whence it follows that the existing makes of lamp last too long. To remedy this defect, M. Hospitalier thinks that the mode of manufacture and the method of standardizing should be modified, so as to make the smashing-point coincide with the average life. Until this is done by the lamp makers, their customers will continue to think that long-lived lamps must necessarily be economical; because the average user will be hard to convince that it is to his advantage to break his lamps after a few hundred hours' service.

TAR-TANK EXPLOSIONS.

It is, of course, too soon to make any attempt to extract a "moral" from the Bradford tar-tank explosion; but the minds of gas managers everywhere are so occupied with the affair, that it seems almost like trifling to talk to them about anything else until the excitement has quieted down. There will naturally be a close inquiry into the circumstances, some results of which may be made known at the adjourned inquest; but a special official report to the Home Office may be expected in due course, which it is to be hoped will throw light upon this at present mysterious occurrence. There is no suggestion of foul play in connection with the explosion; and it will therefore be to the public interest for all the particulars about it to be fully stated and discussed. Every gas engineer responsible for the safe conduct of gas-manufacturing operations at home or abroad will be curious to see a plan of the ill-fated Valley Road Gas-Works, with all the gas and tar connections clearly set out, in order that he may satisfy himself with regard to the probability or the contrary of any explanations of the accident that may be offered. It is no exaggeration to state that during the past week there has been such an overhauling of similar arrangements in gas-works as was never thought necessary before. Where managers of works have not needed to satisfy themselves respecting the safety of their tar-wells and connections, anxious directors and committeemen have naturally enough required reassurances upon this point; and one result of the "scare" will be a substantial increase in the fire insurance of gas-works. How the incident will affect the attitude of the fire offices towards gas-works risks remains to be seen. A tar-well explosion is an exceptional event; but, as the experience of the Bradford Gas Department shows, when it does occur, the consequential damages may be very serious.

Inquiry into a catastrophe of this nature must start with the fact that on a certain occasion an explosive mixture of air with a combustible gas had accumulated in a particular confined space, and was there ignited. First of all, then, we must ask what can have been the composition of the mixture, the answer to which question may or may not explain also how it came where it was found to be; next, we must ascertain why it was confined in this place; and, finally, we have the problem of its ignition. The last is the question of most immediate interest; but the others are of greater intrinsic importance. Ignition of an explosive mixture may happen mysteriously, and through an extraordinary concatenation of favouring circumstances which may never repeat themselves. No conceivable precautions can be fully depended upon to prevent the striking of a spark or the intrusion of a flame in a dangerous place. All that can be done is to render such a thing in a high degree unlikely. The main solicitude of the works manager must be to reduce the chances of a spark or a flame provoking an explosion anywhere, by preventing the formation of dangerous places. Recent years have witnessed a great improvement in this respect in gas-works. It is not so long ago that, after nightfall, whole sections of a gas-manufacturing station were left in darkness because it was thought dangerous (as indeed it was) to approach them with a naked light. The consequence of this, when anything went wrong, was naturally bad. Whatever happened, men could not see their way about; and small troubles were perforce left to grow into great ones for lack of timely attention. The governor-house of the past and present supplies an illustration in point. After the disastrous Nine Elms explosion, the governor was held in something like superstitious awe by the timid, because ignorant, directors, and by not a few engineers who should have known better. For years it was the practice to shut the governor up in a case, as though this expedient could have been of any real service had the apparatus possessed the spirit of malignant mischief ascribed to it; and the governor-house was only lighted by safety-lamps drawing their supply of air from, and discharging their combustion products into, the outside atmosphere. Now the governor-house is a well-ventilated apartment, in, underneath, and around which naked gas-flames are freely burnt, because the conditions of safety in working are better understood and realized.

Clearly, therefore, prudence counsels not so much the shunning of dangerous places in gas-works as their elimination. Quitting for the moment the consideration of how the ignition of an explosive gaseous mixture confined in a tar-well may be brought about, we have to think of how it can come there, and why it remains, a potential source of mischief. For obvious reasons, it is desirable that these questions should be discussed without special reference to what may or may not have been the disposition of the plant at the Valley Road works. We use this occurrence, in short, merely as illustrating the importance of studying the subject generally. As a matter of fact, we have no knowledge, at the moment of writing, of the manner in which the Valley Road tar-tanks were filled or emptied, or anything about them. All that is necessary to state in regard to them is that they were vaults presumably with tar in them, probably covered with some water, yet leaving room in their upper portions for an accumulation of an explosive gaseous mixture. Discussing his experience at Nottingham for the edification of the members of the Manchester District Institution of Gas Engineers, Mr. Chester recently mentioned several ways in which an enclosed tar-tank can become dangerous. In the first place, it is obvious

that gas from a neighbouring pipe may escape into it. This case need not be considered at length, because a gas explosion in a tar-well due to such a cause does not differ essentially from a similarly induced explosion anywhere else. Putting aside this suggestion, therefore, the problem is narrowed down to two issues—of whether the explosive mixture which experience shows is liable to occur in tar-wells is composed of air and tarry vapour, or air and coal gas entrained with the tar, and given up by it after standing quiescent in the tank. Let it be noticed that it is the fact of the tar being enclosed in a covered tank which governs the whole matter. In the open air, tar is harmless; and it is at least possible that, in making the transition from open to covered tar storeage, the eventuality of the tar yielding up something which might be dangerous if not allowed to pass freely away has not always been duly regarded. It is probable, as was remarked in the course of the discussion upon Mr. Chester's Manchester paper, that, at times, tar itself throws up a small quantity of light fluid hydrocarbon which vapourizes at ordinary temperatures; but the most likely contribution of stored tar, and even ammoniacal liquor, to the formation of an explosive mixture with the air confined over it is, as Mr. Chester has suggested, the coal gas which it has entrained with it. And it may be easily understood how the liquor which has been so shaken up with the gas in the process of washing and scrubbing, may carry off mechanically more gas than the tar. At any rate, it seems unnecessary to look for any more occult origin of the explosive character of the atmosphere standing over tar and ammoniacal liquor in a closed tar-tank. It is thus no exaggeration to state that every enclosed tar or liquor well contains within it the germ of mischief. This evil can be mitigated by efficient ventilation; but, as with all artifices having the ventilation of an enclosed space for their object, it does not always follow that the effect produced is a credit to the means employed. Good intentions are in nothing more frequently disappointed than in this matter of ventilation; and there is no guarantee that an underground tar-tank will always get that "change of air" which is denied to the Royal Courts of Justice and many other of our pretentious buildings.

We have now seen that an enclosed tar or liquor well may be a dangerous place in a gas-works, and that this danger grows out of the nature of the operations ordinarily going on in such wells—namely, the settlement of the fluids and the escape from them of bubbles of gas brought from their earlier association with it in the washers, condensers, &c. This danger cannot be eliminated, and must therefore be reduced. Means may be found for inducing the tar and ammoniacal liquor to give up their entrained gas *en route* to the well; and all inlets to, and outlets from the latter can be sealed as snugly as possible, so as to cut off every needless source of danger in the shape of a long length of partly-empty piping, which might serve as a touch-hole to the gaseous mixture in the tank. To keep the atmosphere of the latter in sufficient motion, the space must be ventilated properly; but this is not so easy to do as it is to talk about. It is not sufficient to put up outlet shafts which may be supposed to discharge the exhalations of the tanks into the upper air. Means must be provided for the inlet of fresh air, and for keeping the current always moving in the right direction; and both inlets and outlets must be guarded in a proper manner against the intrusion of sparks or flames. It follows from all this that to make a tightly covered-in tar or liquor tank perfectly safe is no easy matter.

The question of how an explosive gaseous mixture, supposing it to exist in a tar-tank, may be ignited, has been left to the end of this essay; because, while it is a very curious and interesting one, it involves the discussion of such a "chapter of accidents" as can hardly be fruitfully entered upon. Fire comes from a thousand sources; and granting an explosive mixture to be in any way accessible by a flame or a spark, it is practically impossible to tell exactly how or when this contact will be made. In a gas-works where oxide of iron is used for purification, this material may "fire" in strange places; or an irregular Claus sulphur process may start on its own account in a ventilating-pipe—stranger things have happened. And the workman, with his matches, is always amongst us. Some curious reflections upon the origination of fires are suggested by a recently published report of instances culled from the records of an insurance office. One fire was caused by a railway truck, the axle of which had fired through becoming overheated, leaving the metals at a point where it could come into contact with a tank of petroleum, which it ignited, and which in turn set light to an adjoining factory. It is known that greasy waste is liable to fire spontaneously; but in one case a bucketfull of this stuff happened to be placed underneath a machine belt in motion, in such a position that it was touched by the sag of the belt, and the friction thus caused proved sufficient to fire the contents of the bucket. Even the use of heavy mineral lubricating oils and the storing of dirty waste in a place set apart for it, do not guarantee immunity; for in a certain factory, where both precautions were observed, a wandering cockchafer became entangled in the waste, and upon freeing himself made straight for a gas-jet, with most disastrous consequences to himself and to the factory—the flames of his immolation being propagated by the filaments of greasy cotton that still adhered to his body. Bright tinplates acting as condensing mirrors are well-known offenders. It is also on record that a gas-fitter, with even more than the normal carelessness of his kind, having tested a newly-made joint with a light, and not noticing that the gas escaped and lit with a small blue flame, replaced the flooring boards over his job, and went his way. For six weeks the gas continued to burn, after which the flame so increased in size as to char the planks above it; the pungent smell resulting therefrom leading to the arrestation of further mischief. The heat developed by the rapid oxidation of finely-divided iron is considerable; and a factory that had been submerged by an inundation took fire from this cause—a mass of iron filings and combustible rubbish getting damp, and heating to the blazing-point. Not long ago, in New York, the extinguishing by water of a fire in a small building that happened to contain quicklime was the occasion of the starting of another fire which attacked the neighbouring property. The records of the fire offices contain many more striking illustrations of the subtlety with which conflagrations are sometimes started, and in which it is difficult not to suspect the existence of a spirit of wilful wickedness in insensate matter.

The proximate cause of the Nottingham tar-tank explosion of last July remains a mystery to this day. It is to be hoped, however, that this will not be the case with the Valley Road disaster; but that, having done so much damage, this disastrous explosion will reveal its cause and origin, so that gas managers may learn what measures to take to guard against a repetition of such accidents.

Mr. Frank King has been appointed Secretary of the Newport (Isle of Wight) Gas Company, in succession to the late Mr. Arthur Estcourt.

The Flameless Combustion of Natural Gas.—A communication on this subject recently appeared in the *Journal of the Society of Chemical Industry* from Mr. G. L. Cabot. Referring to the well-known phenomenon of the ignition of gas in contact with platinum, he pointed out that this would not occur with natural gas such as is found in Western Pennsylvania. Natural gas always contains aqueous vapour. The pipe-lines through which it passes can be most economically laid and maintained at or near the surface of the ground; and they are usually thus laid except in the large cities. In winter, frost is formed inside them, and it is necessary to have gas-fires burning at intervals along the lines, to prevent them from being plugged. Such fires are often extinguished by accidental causes; and it occurred to Mr. Cabot to put platinized asbestos in front of the escaping gas-jets along his lines, to re-light the gas. When heated to below redness, and exposed to the mixture of natural gas and air escaping from a Bunsen burner, this asbestos quickly attained a bright red heat, but did not ignite the gas. An electric gas-lighter would not ignite natural gas. When this gas is employed in engines, it is found to be necessary to use artificial gas for the smaller flame from which the flash is obtained; the flash of natural gas being too slow. Natural gas requires a much higher temperature for ignition than ordinary coal gas. It has a greater specific gravity; and, as it contains chiefly the homologues of the paraffin series, it may be supposed that its non-inflammability results from its comparatively small percentage of free hydrogen. Another characteristic that may have something to do with it is the absolute freedom from sulphur and from all aromatic hydrocarbons.

Death of Dr. Werner Siemens.—News reached London last Wednesday of the death on the previous day, in Berlin, of Dr. Werner von Siemens, founder of the well-known firm of Siemens and Halske, of Berlin, London, St. Petersburg, and Vienna. Some time ago he had an attack of influenza, which brought on inflammation of the lungs, from which it was thought he would never recover; but he improved, and his last illness was comparatively short. If he had lived till to-day, he would have celebrated his 76th birthday. Dr. Siemens was born at Lenthe, near Hanover, in 1816; and he entered the Prussian Artillery as a volunteer in 1834. From 1841 to 1849, when he retired from the army, he displayed a ceaseless activity in inventing and perfecting, under the auspices of the Prussian Government, various processes of galvanized gold and silver plating. He also devoted himself to constructing and developing the systems of electric telegraphy; the most important of the latter being the first great telegraph line on the Continent—that between Berlin and Frankfort—which he established in 1849. Six of the existing Atlantic cables, as well as many other submarine systems, were laid by Messrs. Siemens Bros., Limited, to the formation of which Company he greatly contributed. In this undertaking he was associated with his brothers William, who died in London in 1883, and Charles, who went to St. Petersburg. Dr. Siemens was the inventor of the pneumatic tube system; and he effected several important improvements in machinery for electric lighting. It is claimed that he was the inventor of the dynamo. He was an honorary member of the British Association, and of most of the European electrical and scientific societies. In 1886 he presented 500,000 marks to the German nation for the foundation of a national scientific and technical institution. In 1888 he was ennobled; and in the same year he published a collection of treatises. The degree of Ph.D. was conferred on him by the Berlin University in 1874. Dr. Siemens's various scientific pursuits must have proved to be very lucrative; for he is reported to have died a rich man.

NOTES.

A Large Gasoline Vapour Engine.

A brief account is given in the *Scientific American* of a large gasoline vapour engine constructed by Mr. James A. Charter, with the object of demonstrating the applicability of this kind of motor to powers beyond the 30-horse limit of size to which they have been popularly supposed to be restricted. The engine is said to be rated at 100-horse power; but it is admittedly worked up to 62-horse power. It may be remarked that the fiction of nominal horse power appears to be differently understood by various makers of engines. In the case of steam-engines and the smaller gas-engines, the nominal horse power is usually less—often considerably so—than the power obtainable from them. In the case of both steam and gas engines of extraordinarily large size, this relation of the nominal to the actual horse power is often reversed—probably for the sake of advertisement. The practice is, however, a very undesirable one. Mr. Charter's gasoline engine drives a large grain elevator at Camden, New Jersey. It is reported to consume one-tenth of a gallon of gasoline of 74° specific gravity per horse power per hour; and as this fluid only costs 6 c. per gallon in large cities in the United States, an engine making fairly economical use of it compares favourably with either a steam or a coal gas engine. In Mr. Charter's motor, the gasoline merely carburets air in the ordinary way; and for the sake of safety there is never more than a pint of the fluid at a time in the reservoir from which the explosive charge is taken for the engine. The starting of the engine is effected by a hand force-pump used in connection with a detonator, which gives the first impulse, after which the automatic feeding-gear comes into operation.

The Hypothetical Ether.

In all treatises dealing with the phenomena of light, very free use is made of the hypothetical "ether" of the physicist, which is a supposititious substance imagined to fill all space, and to be capable of transmitting wave-movements. The conception of this substance is due to the need felt by physicists of something for light, and other so-called undulatory forms of energy which are independent of the atmosphere, to work upon. Action at a distance, without any means of conveying the impulse from its point of origin to the place where it takes effect, is not entertained as a possibility. Consequently, some explanation being required of what becomes of the light of the sun during the 2½ minutes, or thereabouts, which it takes to travel from the sun's disc to the earth's atmosphere, it has been suggested that the intervening space must be filled with something which, for the want of a better name, has been called "ether;" and this convenient assumption is carried through all considerations of the nature and effects of light. It is advisable, however, that students of physical science should be occasionally reminded that hitherto all attempts to obtain experimental corroboration of the fact of the objective existence of this ether, have failed. Professor Lodge has recently endeavoured to ascertain whether the ether possesses the quality of viscosity, which might be expected to be the case if it were of a nature analogous to that of any known gaseous body, however tenuous; but his researches gave only negative results. And recent newspaper discussions respecting the character, dimensions, and movements of Holmes's comet have gone to show that, if there is any material substance corresponding to the name of the ether in inter-planetary space, its nature must be widely different from anything of which we have experience.

Effect of Moisture in Determining the Combination of Gases.

The important bearing of moisture upon the combination of gases, and in some cases even when this combination is attended with combustion, is mentioned by Sir Henry Roscoe in the course of an appreciative notice in *Nature* of a book of chemical lecture experiments recently published by Mr. G. S. Newth. Mr. Newth gives several experimental demonstrations of the fact that many gases, when perfectly dry, do not combine; carbonic oxide and oxygen being of the number. Sir H. Roscoe adds a striking illustration to those mentioned in the book. It is as follows: Dry a current of carbonic oxide over glass balls moistened with strong sulphuric acid; light the stream of gas as it issues from a horizontal tube; then plunge over the blue flame a cylinder full of air which has been previously dried by shaking it up with a little strong sulphuric acid. The flame instantly goes out. This remarkable result of extinguishing a flame of gas by merely dried air is very suggestive of the hidden value that may attach to what are commonly regarded as impurities in chemical compounds and mixtures.

Steam-Boilers and Smoke Prevention.

A good deal of work is being done in the direction of reducing the smoke-producing proclivities of steam-boiler furnaces stoked with bituminous coal; but reliable information respecting the performance of the best of the different types of apparatus employed for this purpose is not easy of attainment. Most smoke-prevention appliances for steam-boiler furnaces may be divided into two chief classes—one including automatic stoking as a part of the object to be attained; the other being intended to operate in connection with hand stoking. Some arrangements may be applied to either kind of stoking. Regular, automatic feeding of boiler fires with roasted, or partially coked coal is in itself a noteworthy means of reducing the smoke; but this style of stoking is unsuited for boilers which are subjected to irregular demands for steam. What is needed in this case is some means of dealing with the smoke resulting from sudden charges of green fuel, which will usually burn smokelessly enough after the first few minutes. A variety of time-regulating devices have been put into more or less successful operation with the above-mentioned object, all of which depend upon the principle of turning an air or steam blast, or both, upon the fresh charge of fuel simultaneously with its introduction into the furnace; these blasts being shut off after a time adjusted with reference to the character of the fuel employed. A test of an arrangement of this kind, the invention of Mr. James Sargent, well known as a patentee of time-locks for safes, &c., is favourably reported upon, both for preventing smoke, and also for increasing the evaporating power of the coal. Not much economy of fuel is now expected, however, from smoke-preventing appliances, the use of which is generally imposed upon boiler users in the public interest.

COMMUNICATED ARTICLE.

COAL GAS: ITS MANUFACTURE, DISTRIBUTION, AND CONSUMPTION.

A Series of Articles for Gas Students.

THE PURIFICATION OF CRUDE GAS.

(*Continued from p.* 903.)

The principal materials now employed in dry purification are hydrate of lime and hydrated oxide of iron. The methods of utilizing these agents vary. In some works, the former is the sole purifying agent employed; in others, it is supplemented by the use of oxide of iron; whereas in others, either lime or oxide (or both, as the case may be) is further supplemented and assisted by the admission into the crude gas, and going forward with it into the purifiers, of oxygen, either mixed with nitrogen as in ordinary atmospheric air, or free, as prepared by the Brin process. Lastly, there is the Cooper coal-liming process, of which it is difficult to speak authoritatively. Theoretically, it should be a successful one; practically, it seems to have given satisfaction in some places, and to have signally failed to do so in others. It is designed to reduce the work of purification in closed vessels; the method adopted being simply to mix a definite proportion of slaked lime with the coal prior to the latter being placed in the retort. The claim for the invention is that the lime effects in the retort, without nuisance and much more cheaply, what in the ordinary way is done in the purifying-house—*i.e.*, the removal of the sulphur compounds; the gas issuing up the ascension-pipe being comparatively pure. Theoretically, the gas should be quite free from these impurities; and the great reduction effected by the process is attested to by the lengthened period during which the purifier will work before becoming "fouled."

The first four methods of dry purification referred to will now be dealt with, in the order in which they are named above.

Purification by Calcium Hydrate.

The preparation of the lime—an oxide of calcium (CaO) obtained by driving off in a burning kiln, the carbon dioxide from the carbonate ($CaCO_3$), commonly known as limestone—prior to charging a box with it, is an important matter, as the efficiency much depends upon the physical condition of the lime. It is usually slaked with water some days before being required; thus having an opportunity of cooling down before being put into use. Otherwise it may "cake" badly in the purifier, and cause back pressure, besides being rendered far less absorbent of the several impurities. The hydrating of the lime is represented by the equation—

$$Ca\,O + H_2O = Ca\,(HO)_2.$$

Before charging the box, the lime is again moistened, and to such a consistency as shall just hold it together, and enable (say) a small quantity that may be gently pressed up in the hand to retain the form thus given. In the purifiers it is placed on wood or iron sieves, which rest on T-iron bearers, carried at intervals across the box and supported from the sides of the box and upon a number of uprights, as has been already described. The number of tiers of sieves varies from three to five, according to the size of the works. In filling the boxes, care should be taken that the lime is *lightly* placed on the sieves; the liability to cake being thereby lessened.

The thickness of the layer of lime will depend on the requirements for the time being, and will vary from 4 to 6 inches. The practice, recommended in some quarters, of placing the lime in a thick body, of (say) from 8 to 10 inches or more, is, in the writer's opinion, wholly bad. The gas is almost certain to find its way through the mass in channels, instead of permeating gently through the whole of the material, as it should do. In some works, it is a practice to reduce rather than increase the thickness of the layers in the winter. This, at a time when the make is at its highest, may seem paradoxical; but the reason for the provision is that, with the accelerated speed at which the gas is passing through the purifiers, the tendency to force channels through the layer, as just described, is greater when it is thick than when it is thin. Moreover, the augmented make may

increase the back pressure to an inconvenient extent; and this, of course, is relieved by the means referred to. It is found in practice that, by adopting this plan, the back pressure can be kept within reasonable bounds; the fouled lime is much better carbonated—*i.e.*, contains a less proportion of free hydrate; and there is therefore less waste of lime.

The reactions in the lime box are as follows: The crude gas, charged with carbonic acid gas and sulphuretted hydrogen, immediately commences to part with these impurities on passing through the lime; carbonates and sulphides and sulphydrates of calcium being formed, thus—

$$Ca(HO)_2 + H_2S = CaS + 2H_2O.$$
$$Ca(HO)_2 + 2H_2S = CaS, H_2S + 2H_2O.$$
$$Ca(HO)_2 + CO_2 = CaCO_3 + H_2O.$$

This goes on until the whole of the calcium hydrate has taken up its equivalent either of sulphuretted hydrogen or carbonic acid gas; that is, *theoretically*, as practically the lime is seldom, if ever, completely saturated. However, when it has thus taken up all of these impurities that it will, another reaction immediately commences. The calcium hydrate has a greater affinity for carbon dioxide than for sulphuretted hydrogen. That portion, therefore, which has been sulphided is decomposed by the further quantities of carbonic acid contained in the crude gas that are still coming forward from the scrubbers, and carbonate is formed, thus—

$$CaS + CO_2 + H_2O = CaCO_3 + H_2S.$$

Sulphuretted hydrogen is thus expelled from the purifier and will continue to be so expelled until the whole of the lime has been carbonated. (This accounts for what, at the time these reactions were less understood, occasionally caused much anxiety, and not a little perplexity—viz., the presence in the gas at the *outlet* of the purifier, of much more sulphuretted hydrogen than it contained at the inlet.) The expelled sulphuretted hydrogen now goes forward to the next purifier; there forming fresh sulphides of calcium, which will so remain until the previous box is fully carbonated. After this the carbonic acid gas will go forward in the crude gas, and decompose this further quantity of calcium sulphide (CaS).

The last-named compound plays a very important part in lime purification. In fact, it is the only medium that has up to now been employed with perfect satisfaction for the removal of bisulphide of carbon. The affinity of sulphides of the alkalies for this impurity has already been referred to in the articles on scrubber purification, where it was seen that the various sulpho-salts of ammonia contained in the ammoniacal liquor assisted materially in arresting some of this impurity, with the formation of a sulpho-carbonate. The reaction with calcium sulphide is similar—

$$(NH_4)_2S + CS_2 = (NH_4)_2S, CS_2$$
$$CaS + CS_2 = CaS, CS_2$$

[The reactions given here, and all through this article, are in their simplest form. The existence of higher sulphides and other compounds in the purifiers is known, with resultant reactions of a more complicated nature. These, however, are all more or less based upon the principles just described, which underlie this method of purification, and which cannot be better described than by the simple equations given above.]

It is thus highly essential that a considerable quantity of sulphide of calcium should be at all times maintained in the purifiers for the elimination of bisulphide of carbon and other like sulphur compounds. To this end, it is necessary to constantly watch the progress of the carbonic acid; otherwise it is liable to overtake the sulphuretted hydrogen, to the destruction of the calcium sulphide purifier.

The late Mr. R. H. Patterson, who was one of the Gas Referees, was, the writer believes, the first to point out the importance of extracting the carbonic acid first, and separately from the sulphuretted hydrogen; and this reference to the ordinary method of lime purification may be fittingly closed by quoting his own description of his process:—

> My process consists in employing the first vessel or vessels of the series in such manner that *the carbonic acid is not only arrested in these vessels, but also is made to expel the sulphuretted hydrogen*, which at first is absorbed by the lime in those vessels, whereby the sulphuretted hydrogen thus driven forward with the gas will be absorbed in the subsequent vessels; converting the lime in these latter vessels into pure sulphide of calcium, which is an efficient material for purifying the gas from bisulphide of carbon.
>
> Suppose that four lime purifiers are employed, the gas may be passed through the first two vessels until carbonic acid appears in the gas issuing from No. 2. As soon as this is the case, No. 1 (the contents of which are now carbonated) is re-charged with fresh lime, and used in the second place in the series; No. 2 being then used as the first. By the time carbonic acid again appears in the gas issuing from the second vessel of the series which was previously No. 1), the lime in the first vessel (previously No. 2) will be fully carbonated; whereupon it is to be re-charged, and used as the second vessel of the series, and so on. In this way, the carbonic acid is wholly removed from the gas by these two first vessels of the series; while the lime which they contain is converted into carbonate, in which state it can be removed from the purifiers without occasioning much nuisance.
>
> In consequence of this method of employing the two first purifiers, the lime in the third purifier is converted into pure sulphide of calcium by means of the sulphuretted hydrogen expelled from Nos. 1 and 2 by the carbonic acid. And as sulphide of calcium absorbs bisulphide of carbon, the gas, in passing through No. 3, will be purified from sulphur in both forms—*i.e.*, both from sulphuretted hydrogen and from bisulphide of carbon. The last vessel of the series, No. 4, will be employed to arrest any sulphur passing forward in the gas from No. 3 When No. 3 (the sulphide of calcium purifier) is re-charged with fresh lime, it may be used last in the series; No. 4, the lime in which is by this time partially sulphuretted, being then placed before it as No. 3. When found advisable (as it may be in some cases), the sulphide of calcium purifier, instead of being at once re-charged with fresh lime, may be transposed into the first or decarbonating series of vessels, where its contents will be gradually carbonated, while sulphur in unusual quantities will be sent forward into the subsequent lime vessels.

The advantages claimed for the invention are, that the carbonic acid and sulphuretted hydrogen being expelled separately, the process facilitates the renovation and utilization of lime and other fouled materials; also, that by complete extraction of the carbonic acid, an increase of 10 per cent. in the illuminating power of the gas so purified is effected—being equivalent to a saving of 10 per cent. in the cost of coals. (The figures here given are Mr. Patterson's.)

The theoretical capabilities of lime for absorbing these impurities may be calculated from the atomic weights as follows:—

$$(a)\quad \frac{Ca(HO)_2}{39{\cdot}9 + (1 + 15{\cdot}96)_2} + \frac{CO_2}{11{\cdot}97 + (15{\cdot}96)_2} = \frac{CaCO_3}{99{\cdot}75} + \frac{H_2O}{17{\cdot}96}$$

$$(b)\quad \frac{Ca(HO_2)}{73{\cdot}82} + \frac{H_2S}{2 + 31{\cdot}98} = \frac{CaS}{71{\cdot}88} + \frac{2H_2O}{35{\cdot}92}$$

$$(c)\quad \frac{CaS}{71{\cdot}88} + \frac{CS_2}{11{\cdot}97 + (31{\cdot}98)_2} = \frac{CaS, CS_2}{147{\cdot}81}$$

$$(d)\quad \frac{CaO + H_2O}{55{\cdot}86 \quad 17{\cdot}96} = \frac{Ca(HO)_2}{73{\cdot}82}$$

We thus deduce from—

(*a*) $\overbrace{Ca(HO)_2}$: $\overbrace{CO_2}$

As 73·82 : 100 :: 43·89 : 59·4 parts by weight, *absorbed* by 100 parts by weight of $Ca(HO)_2$

(*b*1) $\overbrace{Ca(HO)_2}$: $\overbrace{H_2S}$.

As 73·82 : 100 :: 33·98 : 46·03 do. do.

(*b*2) $\overbrace{Ca(HO)_2}$: $\overbrace{CaS}$

As 73·82 : 100 :: 71·88 : 97·4 parts by weight *formed* by 100 parts of $Ca(HO)_2$

(*c*) $\overbrace{CaS}$: $\overbrace{CS_2}$

As 71·88 : 97·4 :: 75·93 : 102·9 parts by weight *absorbed* by 97·4 parts CaS, obtained from 100 parts $Ca(HO)_2$

(*d*) $\overbrace{Ca(HO)_2}$: $\overbrace{CaO}$

Then, as 73·82 : 100 :: 55·86 : 75·7 parts by weight of CaO required to produce 100 parts of $Ca(HO)_2$.

Therefore, taking 1 lb. as a unit, we find that 1 lb. of perfectly pure hydrate of lime or 0·757 lb. of perfectly pure lime, the whole of which has been burned to the oxide, will absorb 0·59 lb. of CO_2, or 0·46 lb. of H_2S, and 1·03 lbs. of CS_2.

In comparing these figures with the results actually attained in every-day practice, the student must bear in mind several important considerations. For instance, the lime used is not perfectly pure. A certain percentage will be inactive, and may consist of portions of the original limestone not properly burned and oxidized, or of other foreign matters. Then, again, portions of the hydrate remain free after the purifier has been turned off as "fouled." It is impossible to perfectly carbonate the lime in the purifier, as, before this result can be attained, such large quantities of carbonic acid would be passing over to the next box, and the next, as would seriously endanger the calcium sulphide purifier. Further, the reactions named are partly simultaneous. So it is here, as with all chemical operations on the large scale, that theory and practice only go hand in hand together in so far as the former may indicate the correct and successful course for the latter to pursue.

The quantity of quicklime required for the purification of the gas produced from a ton of coal is given by Mr. Newbigging as from 60 to 80 lbs.; and from 90 to 140 lbs. for the gas from a ton of cannel. These figures apply to the ordinary process of lime purification, where the use of air or oxygen is not in operation.

The following paragraphs are from Mr. Newbigging's "Handbook." They should be of interest to the student; and they will be of service as we proceed with this article:—

> The value of limestone as a purifying agent is in inverse proportion to the amount of earthy or foreign matter it contains. That which leaves the smallest proportion of insoluble sediment on being dissolved in diluted acid is the best.
>
> *Limestone* is the carbonate of lime found in its natural state, from which the oxide of calcium (quick or caustic lime) is produced by the expulsion of the carbonic acid by means of heat in the limekiln.
>
> *Quick or Caustic Lime* (oxide of calcium) is lime in the solid state before absorbing, or being slaked with, water.
>
> *Hydrate of Lime* is lime in a moist state. It is a chemical compound of lime and water in the proportion of one part of water to three parts of lime.
>
> *Milk of Lime, or Cream of Lime*, is a mixture or solution of hydrate of lime and water.

Weight and Measurement of Lime.

1 bushel of quicklime weighs about	. . . . .	70 lbs.
1 cubic foot of " "	. . . . .	54 "
1 cubic yard of " "	. . . . .	1460 "
1 ton of quick lime is equal to about	. . . . .	32 bushels

(*To be continued.*)

TABLE TO FACILITATE THE CORRECTION OF THE ILLUMINATING POWER OF GAS,

The Tabular Number Corresponding to Different Temperatures and under Different Atmospheric Pressures being known.

Calculated and Arranged by Mr. WALTER GRAFTON.

Tabular Number.	12 Candles.	13 Candles.	14 Candles.	15 Candles.	16 Candles.	17 Candles.	18 Candles.	19 Candles.	20 Candles.	21 Candles.
·920	1·04	1·13	1·21	1·30	1·39	1·47	1·56	1·65	1·74	1·82
·922	1·01	1·10	1·18	1·27	1·35	1·43	1·52	1·61	1·69	1·77
·924	0·98	1·06	1·15	1·23	1·31	1·40	1·48	1·56	1·64	1·72
·926	·95	1·03	1·12	1·20	1·27	1·36	1·44	1·52	1·60	1·68
·928	·93	1·00	1·08	1·16	1·24	1·32	1·40	1·47	1·55	1·63
·930	·90	0·98	1·05	1·13	1·20	1·28	1·35	1·43	1·50	1·58
·932	·87	·94	1·02	1·09	1·16	1·24	1·31	1·38	1·46	1·53
·934	·84	·91	0·99	1·06	1·13	1·20	1·27	1·34	1·41	1·48
·936	·82	·88	·96	1·02	1·09	1·16	1·23	1·30	1·37	1·43
·938	·79	·86	·92	0·99	1·06	1·12	1·19	1·25	1·32	1·39
·940	·76	·83	·89	·95	1·02	1·08	1·15	1·21	1·27	1·34
·942	·73	·80	·86	·92	0·98	1·04	1·11	1·17	1·23	1·29
·944	·71	·77	·83	·89	·95	1·00	1·07	1·13	1·19	1·24
·946	·68	·74	·79	·85	·91	0·97	1·03	1·08	1·14	1·20
·948	·65	·71	·76	·82	·87	·93	0·99	1·04	1·10	1·15
·950	·63	·68	·73	·79	·84	·89	·95	1·00	1·05	1·10
·952	·60	·65	·70	·75	·80	·85	·91	0·96	1·01	1·06
·954	·58	·62	·67	·72	·77	·82	·87	·91	0·96	1·01
·956	·55	·59	·64	·69	·73	·78	·83	·87	·92	0·96
·958	·52	·57	·61	·65	·70	·74	·78	·83	·87	·92
·960	·50	·54	·58	·62	·66	·70	·75	·79	·83	·87
·962	·47	·51	·55	·59	·63	·67	·71	·75	·79	·83
·964	·45	·48	·52	·56	·60	·63	·67	·71	·75	·78
·966	·42	·46	·49	·53	·56	·59	·63	·67	·70	·74
·968	·40	·43	·46	·50	·53	·56	·59	·62	·66	·69
·970	·37	·40	·43	·46	·49	·52	·55	·59	·62	·65
·972	·34	·37	·40	·43	·46	·49	·52	·55	·57	·60
·974	·32	·34	·37	·40	·42	·45	·48	·51	·53	·56
·976	·29	·32	·34	·37	·39	·41	·44	·46	·49	·51
·978	·27	·29	·31	·34	·36	·38	·40	·42	·45	·47
·980	·24	·26	·28	·30	·32	·34	·36	·39	·41	·43
·982	·22	·23	·25	·27	·29	·31	·33	·35	·36	·38
·984	·19	·21	·22	·24	·26	·27	·29	·31	·32	·34
·986	·17	·18	·19	·21	·22	·24	·25	·27	·28	·30
·988	·15	·16	·17	·18	·19	·20	·21	·23	·24	·25
·990	·12	·13	·14	·15	·16	·17	·18	·19	·20	·21
·992	·10	·10	·11	·12	·13	·13	·14	·15	·16	·16
·994	·07	·08	·08	·09	·10	·10	·11	·11	·12	·12
·996	·05	·05	·05	·06	·06	·07	·07	·07	·08	·08
·998	+ ·02	+ ·03	+ ·03	+ ·03	+ ·03	+ ·03	+ ·04	+ ·04	+ ·04	+ ·04
1·000	·00	·00	·00	·00	·00	·00	·00	·00	·00	·00
1·002	− ·02	− ·03	− ·03	− ·03	− ·03	− ·03	− ·04	− ·04	− ·04	− ·04
1·004	·05	·05	·05	·06	·06	·07	·07	·08	·08	·09
1·006	·07	·08	·08	·09	·10	·10	·11	·11	·12	·13
1·008	·10	·10	·11	·12	·13	·14	·15	·16	·16	·17
1·010	·12	·13	·14	·15	·16	·17	·18	·19	·20	·21
1·012	·15	·16	·17	·18	·19	·20	·21	·23	·24	·25
1·014	·17	·18	·19	·21	·22	·23	·25	·26	·28	·29
1·016	·19	·21	·22	·24	·25	·27	·28	·30	·32	·33
1·018	·21	·23	·25	·27	·28	·30	·32	·34	·36	·38
1·020	·24	·26	·28	·30	·32	·34	·36	·38	·40	·42
1·022	·26	·28	·31	·33	·35	·37	·39	·41	·44	·46
1·024	·29	·31	·34	·36	·38	·40	·43	·45	·47	·50
1·026	·30	·33	·36	·39	·41	·44	·46	·49	·51	·54
1·028	·33	·36	·39	·41	·44	·47	·49	·52	·55	·58
1·030	·35	·38	·41	·44	·47	·50	·53	·56	·59	·61
1·032	·38	·41	·44	·47	·50	·53	·56	·59	·62	·66
1·034	·40	·43	·46	·50	·53	·56	·60	·63	·66	·70
1·036	·42	·45	·49	·53	·56	·60	·63	·66	·70	·73
1·038	·44	·47	·52	·55	·59	·63	·66	·70	·74	·77
1·040	·47	·50	·54	·58	·62	·66	·70	·73	·77	·81

TECHNICAL RECORD.

A COMPANION TABLE TO APPENDIX "C" OF THE GAS REFEREES' NOTIFICATION.

The preceding table, which has been calculated and arranged by Mr. Walter Grafton, will, we think, be found by gas examiners a very useful companion to Appendix "C" of the Referees' Notification. It can be employed in making corrections for temperature and atmospheric pressure by adding the parts of a candle given in the columns to the illuminating power of gas which has not been subject to any correction for volume of gas. It will save much labour and time in calculating, and, besides, will lessen the likelihood of error. Its application is similar to that of the Referees' table above referred to, with this exception—that the parts of a candle are to be added or subtracted. To find the parts to be added, which come between the columns, when the tabular number is an odd one and below 1·000, read across in an upright instead of in a downward direction; but read in the latter direction when the number is above 1·000.

The figures have been carefully ascertained to the second place of decimals; and they will be found accurate for all tenth parts of a candle to be corrected. The correction for the parts of a candle is most readily done by converting into parts of 10, and then taking the required parts of the difference between the specified amounts allotted to the whole candles which the uncorrected figures affect, and adding the quantity to the allowance of the least whole number.

Example I.—Tabular number, ·981; quality of uncorrected gas, 15·80 candles. What is the corrected illuminating power?
Opposite ·982, and under heading 15, will be found 0·27
" ·980, " " 16, " " 0·32
being a difference of 0·05. The 0·8 is four-fifths of a candle more than 15; therefore four-fifths of 0·05 is 0·04, which is to be added to the number corresponding to ·982 and 15—viz., 0·27 + 0·04 = 0·31. This number added to 15·8 gives the corrected illuminating power as 16·11 candles.

Example II.—Tabular number ·966; uncorrected illuminating power, 17·52 candles.
Opposite ·966, and under heading 17, will be found 0·59
" " " " 18, " " 0·63
being a difference of 0·04. This divided by ½ candle gives 0·02, to be added to 0·59 = 0·61. This number added to 17·52 gives the corrected illuminating power as 18·13 candles.

Example III.—Tabular number, 1·013; quality of uncorrected gas, 20·7 candles.
Opposite 1·012 and under heading 20 will be found 0·24
" 1·014 " " 21 " " 0·29
being a difference of 0·05. The 0·7 is seven-tenths of a candle more than 20; therefore seven-tenths of 0·05 is 0·03, which is to be added to the number corresponding to 1·012 and 20—viz., 0·24 + 0·03 = 0·27. Subtracting this number from 20·7 gives the corrected illuminating power as 20·43 candles.

The table will also be found useful in correcting the volume of gas, by substituting feet or grains of sulphur for candles.

THE GENERATION OF LIGHT FROM COAL GAS.

Professor Vivian B. Lewes's Cantor Lectures at the Society of Arts.

On Monday, the 5th inst., Professor VIVIAN B. LEWES, F.I.C., F.C.S., Chief Gas Examiner to the Corporation of London, gave the third of the series of Cantor Lectures on the above subject now in course of delivery by him at the Society of Arts. As on previous occasions, there was a large attendance; and the lecturer's remarks, and the experiments by which they were accompanied, were followed with much interest.

Professor Lewes began by remarking that he had brought before his audience the work on which our present ideas as to the source of the luminosity in hydrocarbon flames are based; and he said he could not but think that the evidence collected by Davy, Stein, Heumann, Soret, Burch, and Stokes, had fully established the truth of the solid particle theory first enunciated by Davy. In admitting this, however, the debt we owe to Dr. Frankland must not be overlooked; as, although the mass of evidence seemed conclusively to point to carbon particles, and not incandescent hydrocarbon vapours, being the cause of luminosity in coal gas, oil-lamp, and candle flames, had it not been for his putting forward his theory, and supporting it in the way he did, the scientific world would probably never have had the masterly work by which Heumann conclusively established the truth of Davy's hypothesis, or the smaller contribution which had so strengthened its position.

Two years ago, continued the lecturer, I had the honour of delivering before you a course of Cantor Lectures on "Gaseous Illuminants,"* and, while searching flame lore, in order to find the exact position of our theories as to luminosity, it seemed to me that, in the present position of our knowledge, what was really required was to show how and why those all-important carbon particles came to be formed in the flame. Was it, as Davy supposed, brought about by the heat of the outer portion of the flame decomposing the hydrocarbons in the interior regions, where air was scanty or altogether wanting, into their constituents; or was it, as others supposed, some unfinished combustion which gave the particles to the flame, and so endowed it with luminosity? Could it be that Frankland was right, and that what had been called "solid particles" of carbon were in reality the densest possible vapours of hydrocarbons? If so, how could they have been produced from the hydrocarbons we know to be present in coal gas? and was the temperature of a luminous flame sufficient to cause incandescence of such vapour, and not to decompose it? These and a hundred other like thoughts came as a recreation from duller routine work; and experiments, made whenever time could be found by myself and my assistants, have revealed another step in our flame reaction, and have made clearer changes which before had to be explained by assumptions.

In the last lecture of the former series, I dealt with the products of incomplete combustion which escape into the air when the combustion of a flame is checked by practically putting it out before combustion is complete, by withdrawing the heat of the flame for raising the temperature of other things in our gas-stoves and ovens. Whenever a luminous flame is treated in this way, an insidious and disagreeable odour pervades the room; while if an atmospheric or Bunsen burner flashes back and burns at the bottom, the same smell becomes almost unbearable. This curious smell has long since been recognized as acetylene—one of the simplest of the gaseous hydrocarbons; and its undoubted presence in the products escaping from a cooled flame, and the fact that the incomplete combustion of hydrocarbon gases always gives rise to its formation, suggested the idea that it might play an important part in the changes taking place in the interior of a flame. Experiments were accordingly made to ascertain if any appreciable quantity of this compound was formed by the destruction of hydrocarbons in the flame gases. The fact that the unsaturated hydrocarbons only slowly decrease in the inner zone, and then rapidly disappear in the luminous part of the flame, has naturally suggested the idea that it is to these compounds that the flame owes its luminosity. But, as far as I know, no one has attempted to ascertain whether the unsaturated hydrocarbons present at the top of the inner non-luminous zone are of the same character as those found in coal gas.

I had just completed working out these points, when, in December last year, Professor Smithells, of the Yorkshire College, Leeds, read a most interesting paper before the Chemical Society on "The Structure and Chemistry of Luminous Flames;"* and, as this was published a month before my results, it will be better to take it in its historical sequence. He devised a most beautiful experiment by which he was able to show that the Bunsen flame consists of two distinct cones of combustion, which can be separated widely apart; the reason being given as follows:—

> When a Bunsen flame is burning at the top of a tube in the ordinary way, the coal gas is in such excess that the mixture within the tube is scarcely explosive. If now the proportion of coal gas to air be diminished, the mixture within the tube becomes more explosive, and the initial velocity of inflammation of this mixture increases as the proportion of air is increased up to a certain point. Long before enough oxygen is mixed with the gas for its complete combustion, the explosibility of the mixture has reached such a point that the velocity of inflammation is greater than the velocity of efflux from the tube; and so the flame is differentiated into two cones, one of which descends the tube, and marks the margin of the explosive mixture, while the other marks the area of the combustion of the combustible gases which have escaped combustion in the lower cone, and are burning at the top of the tube in free air. The rate at which the inner cone will descend the tube will depend upon several conditions, one of which is the temperature, and another the diameter of the tube; and these conditions suggested a means of arresting the lower cone of flame. By heating the glass tube with a blowpipe flame at a point about a foot below the top, it was found possible to arrest the inner cone when reascending; the high temperature producing locally a velocity of inflammation greater than that at points above or below, and so fixing the flame. The second method suggested by the foregoing considerations was simply to diminish the diameter of the tube at one point, either by means of a metal diaphragm, or by slightly drawing out the tube so as to cause a constriction. At the narrow part of the tube, the velocity of the ascending gas mixture is obviously greater than elsewhere; and hence a flame which will descend the wider part of the tube will be arrested at this point. With this apparatus, the flame could be divided with the greatest ease; and the two regions of combustion kept separate for any length of time.

Having in this way separated the cones of various hydrocarbons burning with excess of air, Professor Smithells was able to withdraw samples of the interconal gases, and subject them to analysis; and he found that the main chemical change occurring in the inner cone under these conditions consists in the combustion of the hydrocarbons to form carbon monoxide and water, with smaller quantities of carbon dioxide and hydrogen. He also notes that, when the air was insufficient to destroy luminosity, some acetylene came from the inner cone.

* See JOURNAL, Vol. LVI., pp. 1140, 1194, 1240, 1288.

* See JOURNAL, Vol. LIX., p. 68.

In dealing with the question of the structure of luminous flames, he points out as follows:—

The glow of the carbon in the yellow region is due to the heat of its own combustion, and is increased probably by the concomitant combustion of hydrogen. The view occasionally met with, that the carbon is glowing only by the heat of the burning hydrogen, is manifestly erroneous. The carbon is in the solid state, and must either undergo the usual glowing combustion, or else escape from the flame unburned. As it does not do the latter to any appreciable extent, it must burn; and the cessation of its combustion as a solid marks the limit of the yellow or luminous region of the flame.

The blue region has been unanimously regarded as a part of the flame where the hydrocarbons are mixed with sufficient air to cause immediate combustion, without the separation of carbon. The faintly luminous portion, which entirely surrounds the flame, was not referred to by Davy as distinct from the blue region. Berzelius describes it, and states "that it is in this outer part that the combustion of the gases is completed, and the heat is the most intense." Waldie states that it consists of "the proper combustible mixture," and is the hottest part of the flame, and that to its heat is to be attributed the separation of the carbon within the flame.

No intelligible distinction appears to have been made between this region and the blue one until 1861, when Kersten attempted to do so; and even his description is not easy to grasp. He appears to have regarded the faintly luminous region as the place in which hydrogen and carbon monoxide coming from the yellow region undergo combustion; ignoring the fact that it surrounds not only the yellow region, but the blue one as well. I have only met with one other attempt to explain this part of a luminous flame as distinct from the blue portion, and have not been able to trace it beyond the text-books. It ascribes this faintly luminous region to products of combustion—carbon dioxide and water—mixed with air and raised to feeble incandescence; that is, it is not a region of chemical action at all. If for no other reasons, this explanation could scarcely be maintained in the face of the observations made by Siemens, that such products of combustion have no perceptible luminosity at 1500°.

The best way to study flame structure seems to me to consist in tracing the development of the flame. By using a very small quantity of combustible—that is to say, in the case of gases, by almost turning off the tap, and, in the case of solids and liquids, by having a very close cropped wick—we obtain a tiny flame which is ordinarily called non-luminous. It consists of a hollow bright blue cone, surrounded by a lilac-coloured border. If more gas is turned on, or if the wick becomes longer, a luminous spot is developed in the flame. This spot is at first a small fraction of the whole flame; but as the supply of combustible is increased, it rapidly extends, the original inner cone becomes a "vestige," and forms, in fact, the blue region. Still the original formation is evident; the luminous spot being indented at points corresponding to it.

The question now arises: Is the non-luminous flame a single or a double cone, and, in any case, what chemical changes are taking place in it? I think an answer to this question may be obtained by carefully watching the change undergone by a luminous flame when air is gradually added to the gas prior to combustion. For this purpose, a small flame from a Bunsen burner, with the air-holes at first closed, may be employed. If attention is fixed on the blue and on the faintly luminous regions of the flame, and the air-holes are now slowly opened, the flame loses luminosity, and the two regions grow more distinct, and ultimately become, without any perceptible break of continuity in the process, the inner and outer cones of the ordinary Bunsen flame. If the conclusion be admitted that the blue and the faintly luminous regions of an ordinary flame correspond to the inner and outer cones of a Bunsen flame, then we must consider the blue region to mark incomplete combustion—CO, H_2, CO_2, and H_2O being the chief substances there originating—and the faintly luminous part to mark completed combustion; the CO and H_2 above named being burnt to CO_2 and H_2O. In other words, I conclude that there is no essential difference in kind between an ordinary luminous flame and a so-called non-luminous flame. The latter may be regarded as a gas-air flame with the blue and the non-luminous regions at a maximum; while the luminous flame is to be regarded as a gas-air flame with the blue and the non-luminous part at a minimum, and the yellow luminous region at a maximum. As it has been repeatedly shown that the dark central part of a luminous flame is a region of no combustion, there only remains now one question for solution: How is the carbon separated in the luminous yellow region?

Professor Smithells finally describes the development of a luminous hydrocarbon flame, as follows:—

The hydrocarbon issues from the burner or wick, let us suppose, as a cylindrical column. This column is not sharply marked off from the air, but is so penetrated by the latter that we must suppose a gradual transition from the pure hydrocarbon in the centre of the column to the pure air on the outside. Let us take a thin, transparent slice of the flame near the lower part of the wick or close to the burner. At what lateral distance from the centre will combustion begin? Clearly, where enough oxygen has penetrated the column to give such partial combustion as takes place in the inner cone of the Bunsen burner. This, then, defines the blue region. Outside this the combustion of the carbon monoxide, hydrogen, and any hydrocarbons which pass from the blue region takes place, and constitutes the faintly luminous region. These two layers form a sheath of active combustion, surrounding and intensely heating the hydrocarbons in the central parts of the column. These heated hydrocarbons rise, and are heated to a higher temperature as they ascend. They are accordingly decomposed, with the separation of carbon in the higher parts of the flame—giving us the yellow region; but there remains a central core, in which there is neither any oxygen for combustion nor sufficiently high temperature for decomposition. This constitutes the dark region of unburnt gases. A flame is, however, not cylindrical, but has a conical or, in the case of a candle, an inverted peg-top shape. Again, the blue region only surrounds the lower part of the flame, while the faintly luminous part surrounds the whole. The above explanation is therefore not complete. Let us suppose that the changes have gone on in the small section of the flame exactly as described, and consider how the processes will differ in parts above this section. The central core of unburned gases will pass upwards; and we may treat it as a new cylindrical column which will undergo changes just as the original one—leaving, however, a smaller core of unburned gases, or, in other words, each succeeding section of the flame will be of smaller diameter. This gives us the conical structure of the flame. Again, the higher we go in the flame, the greater proportionally is the amount of separated carbon; for we have not only the heat of laterally outlying combustion to effect decomposition, but also that of the lower parts of the flame. The lower part of a luminous flame is accordingly cooler, and contains less separated carbon, than the upper. Now, where the hydrocarbons are cool until mixed with sufficient air for combustion—that is, in the lower parts of the flame—we have every facility for the occurrence of the chemical changes to which the existence of the blue region has been ascribed; and the blue region is here most evident, whereas in the upper part of the flame, where the quantity of hydrocarbon decomposed, with separation of carbon, by heat is relatively much greater, there is not enough left to form, outside the yellow part, the mixture to which the blue region of the flame is due. The blue region therefore rapidly thins off as we ascend the flame. But whether or not the first combustion taking place within the flame is that of the undecomposed hydrocarbon with limited oxygen, we may be sure that the products will contain carbon monoxide, and probably hydrogen; and we shall therefore have all round the flame a faintly luminous region of complete combustion. In this way, then, we may reasonably account for the existence, position, and relative sizes of the four regions of an ordinary luminous flame.

Professor Lewes then proceeded to refer to his own work on the subject, which he thought supplied the true answer to the query put by Professor Smithells—viz., "How is the carbon separated in the yellow luminous region?" On this matter he said: In attacking this point, I felt that the changes and actions must be sought for in the non-luminous zone of the flame itself; and I chose for the experiments an ordinary coal-gas flame. The gas used was the South Metropolitan Company's and analyses gave the following as its composition:—

Hydrogen	57·08
Unsaturated hydrocarbons (acetylene, 0·035)	4·38
Saturated hydrocarbons	33·99
Carbon monoxide	2·63
Carbon dioxide	0·79
Nitrogen	0·96
Oxygen	0·15
Carbon bisulphide	0·02

This gas, when burnt in a standard "London" Argand at the rate of 5 cubic feet per hour, has an illuminating value which averages 16·3 candles. The gas was consumed at the end of an open tube; and the flame gases were aspirated from the centre of the flame by means of a small platinum tube 2 mm. in diameter, and were led into a glass bulb-tube, in which the sample for analysis of the total hydrocarbons was collected, and then through two Volhard's absorbing bottles, containing 20 cc. of concentrated ammoniacal silver nitrate solution. This absorbed the acetylene, with formation and precipitation of silver acetylide and silver; the latter being formed owing to the reducing action of the carbon monoxide—two absorbing vessels being quite sufficient to prevent any traces of the gas escaping absorption. The contents of the two bottles were filtered, the precipitate of silver acetylide carefully washed with water, and then treated on the filter very cautiously with dilute hydrochloric acid, until all action ceased. Acetylene was given off, and the precipitate then consisted of a mixture of silver chloride and metallic silver. This, after washing, was digested with dilute ammonia; and the ammoniacal solution, after filtration, was then treated with nitric acid to precipitate the chloride, which was weighed in the usual manner—1 gramme of silver chloride corresponding to 0·09 gramme, or 87·03 cc. of acetylene.

Acetylene Formed during the Incomplete Combustion Taking Place in the Interior of a Luminous Flame.

	Total Unsaturated Hydrocarbons.	Acetylene.
Gas in burner	4·38 p. ct.	0·045 p. ct.
½ inch above rim of burner	4·00 „	0·340 „
1½ inches „ „	1·53 „	0·560 „
Tip of inner cone	1·98 „	1·410 „
Centre of luminous zone	0·45 „	0·045 „
Tip of luminous zone	nil.	nil.

This shows that, in the interior of the luminous flame, the hydrocarbons at once begin to undergo decomposition; giving rise to acetylene, which, by the time the top of the inner non-luminous zone is reached, constitutes more than 70 per cent. of the unsaturated hydrocarbons present. A small proportion of the other hydrocarbons, however, remains undecomposed, and penetrates into the luminous zone, where it and the acetylene are both decomposed by the higher temperature attained, a carbon is liberated, and this being for a moment heated to incandescence gives luminosity to the flame.

An ordinary flat flame was now experimented with; the gases being withdrawn and analyzed in the same way as before. The following were the results:—

Acetylene Formed in the Inner Zone of a Flat Flame from a No. 7 Bray Burner.

Portion of Flame.	Total Unsaturated Hydrocarbons.	Acetylene.	Other Unsaturated Hydrocarbons.
½ inch from top of burner	3·505 p. ct.	0·115 p. ct.	3·450 p. ct.
1½ inches from burner	2·063 „	1·303 „	0·760 „
1¾ „ „	1·393 „	1·133 „	0·260 „
2½ „ „	trace.	trace.	—— „

These figures show that, by the time the top of the non-luminous portion of the flame was reached, upwards of 81 per cent. of the hydrocarbons present had been converted into acetylene. In such a flame, luminosity commences just above the 1¾ inches above the burner; and, if luminosity is caused by acetylene, it is natural to ask, Why should it not have commenced at 1¼ inches—a spot where the acetylene is present in larger quantity than at the higher point? The reason for this is that, in order to cause luminosity, a temperature must be obtained at which the acetylene is dissociated; and the point at which this takes place marks the commencement of luminosity. If this temperature is not attained, then the acetylene, in the presence of oxygen, burns away with a non-luminous flame; or, if no oxygen is present, it polymerizes into a number of higher hydrocarbons. If, on the other hand, a sufficiently high temperature is reached to cause dissociation, the liberated carbon becomes incandescent, chiefly from its own combustion, but partly also from the combustion of the hydrogen liberated at the same time, and luminosity is the result.

The temperature needed to cause the dissociation of acetylene varies with the amount of dilution. The more diluted it is, the higher is the temperature necessary to break it up; while the larger the quantity of acetylene, the lower the temperature needed to cause its dissociation, and the smaller therefore the inner non-luminous zone of he flame. In the flame from ordinary coal gas, there is only from 1·1 to 1·3 per cent. of acetylene found in the inner zone. In this highly diluted condition, it requires a temperature of close upon 1200°C. to break it up; while in other flames richer in hydrocarbons, and therefore richer in acetylene in the inner zone, the temperature required is not so high. For example—

	Flame of Coal Gas.	Flame of Paraffin Lamp.
Percentage of acetylene	1·133 ..	2·222
Temperature at commencement of luminous zone	1267°C. ..	1062°C.

The fact that, unless the requisite temperature is reached, the acetylene burns away with non-luminous combustion is, I think, clearly shown by the following experiment: The flame of burning alcohol has in it more than half the quantity of acetylene that a good gas-flame contains, and yet the combustion is practically non-luminous. If a dish containing some alcohol is placed under a bell-jar, it burns with a flame having slightly luminous edges; and the temperature of the flame in this condition is 1220°C. If a glass plate is put over the mouth of the bell-jar for a few moments, the mixing of the products of combustion with the air lowers the rate of combustion, and the temperature of the flame falls to 1050° C.—the flame becoming perfectly non-luminous; while if oxygen is admitted to the bell-jar, the combustion is increased, the temperature rapidly rises to 1510°C., and the flame becomes nearly as luminous as a coal-gas flame, and deposits carbon on any cold surface held in it. Again, if a small luminous gas-flame is allowed to play upon the bottom of a platinum dish, so much heat is abstracted from the flame that the temperature falls below the point necessary to break up the acetylene, and the flame becomes non-luminous; while if the flame is permitted to remain in contact with the metal until the dish is red hot, the luminosity returns. The same effect may be produced by heating the interior of the dish with a blowpipe flame. This experiment was devised by Heumann in order to show the effect of cooling on luminosity.

In every flame I have examined which owes its luminosity to the presence of hydrocarbons, these bodies are converted into acetylene before luminosity commences in the flame; and every gaseous hydrocarbon which can, by means of heat, be made to deposit carbon, is converted into acetylene before any deposition takes place. Many of the hydrocarbons present in coal gas are known to give out heat during their decomposition; but probably the most endothermic of these compounds is the acetylene—Thomson having shown that no less than 55,000 units of heat are absorbed in the formation of 26 grains of acetylene, while only 10,880 disappear in the production of 28 grains of acetylene. It is this which renders so easy its decomposition by heat, or, as shown by Berthelot, even by detonation into carbon and hydrogen. The fact that acetylene is formed from the gaseous hydrocarbons present in illuminating gas prior to the emission of light does not, however, by itself, in any way disprove Dr. Frankland's theory that luminosity is due to very heavy hydrocarbon vapours, and not to solid particles of carbon, as the well-known tendency of the acetylene to polymerize into higher bodies might be taken as an explanation of the presence of sufficiently dense hydrocarbons in a flame given by (say) pure ethylene.

In order to determine whether or not the acetylene formed in the earlier stages of the flame renders it luminous by liberating carbon during dissociation, as required by Davy's theory, or by forming heavier hydrocarbons, a long series of experiments was made to ascertain the effect of heat upon the hydrocarbons present in coal gas, and, by specially-devised apparatus, to measure the actual temperature to which the gases were being heated, and to collect and analyze the resulting products. In 1805, William Henry showed that, when electric sparks were passed for some time through ethylene, the volume increased; and, although the action was far from complete, he was able to show that, at the temperature of the spark, all the ethylene which had disappeared had decomposed according to the equation—

$$C_2H_4 = C_2 + 2H_2;$$

the carbon being deposited on the poles and on the sides of the tubes. The same thing was noticed by other observers; and in 1860, H. Buff and A. W. Hofmann showed that, by heating ethylene by means of a platinum wire sealed into a tube containing the gas, and through which a powerful current was passing so as to raise it to redness, a deposition of carbon was produced, but no increase in volume. From this they concluded that the ethylene had decomposed into marsh gas and carbon—

$$C_2H_4 = C + CH_4,$$

an equation which has been reproduced in every text-book since that date. They then passed electric sparks through the gas, and in twenty-five minutes its volume was nearly doubled; and analysis showed that no marsh gas was present in the residual gas, which consisted of hydrogen, having, as they say, an unpleasant odour, and burning with a slightly luminous flame.

No secondary products have been observed by anyone when passing electric sparks through ethylene, except De Wilde, who found small quantities of acetylene; but Berthelot has obtained traces of acetylene from carbon and hydrogen alone under these conditions. The experiments of William Henry support the above conclusion; for, although the decomposition was by no means complete, the only products obtained were carbon and hydrogen, together with undecomposed ethylene. At temperatures lower than that of the electric arc, the decomposition of ethylene is not so simple. This is indicated by the experiments of the Dutch chemists, of Grove, and of Buff and Hofmann, to which reference has already been made. The latter chemists obtained marsh gas and carbon by the use of a heated platinum wire. The experiments of Grove are not in strict accordance with this; but, as the spirals were not necessarily heated to the same temperature, perfect agreement could not be expected. The experiments indicate, however, that the next stage preceding complete separation is a decomposition into marsh gas, without the formation of any more complex products.

It has been noticed by various observers, amongst whom is Magnus, that, at still lower temperatures, much more complex actions take place; and at about 400° C., the heating of ethylene gives rise to liquid products which Berthelot has shown not to be a single substance, but a mixture of several liquids, among them benzene, styrene, and other liquids with higher boiling-points. He found a trace of acetylene in the gaseous residue, and claimed that a large portion of ethane was formed; and on this basis he supposed that the decomposition of ethylene by heat consists in a splitting of two molecules of ethylene into acetylene and ethane, and that the formation of liquid products is due to a subsequent condensation of the acetylene into more complex products. Day also made a number of experiments upon the changes effected in ethylene by heating; and he came to the following conclusions:—

(1) Ethylene undergoes change by the action of the heat at a temperature very much lower than has been observed in previous investigations.
(2) The temperature at which ethylene begins to alter in constitution is about 350° C.
(3) The change at this temperature consists in condensation without the formation of members of any series of hydrocarbons having a different percentage of carbon and hydrogen from ethylene. The change is slow—requiring at least 20 hours before it ceases; and it is not then complete.
(4) If ethylene is heated to 400° C. for a sufficient length of time, it is entirely decomposed, with formation of marsh gas, ethane, and liquid products.

I have been working upon the decompositions which ethylene undergoes; and I find that it decomposes in two ways, according to the method in which heat is applied. If the gas is kept sealed up in a glass tube at a temperature of 400° C., it decomposes into ethane and acetylene—the latter then polymerizing into the various compounds noticed by Berthelot; but if, on the other hand, the ethylene is passed through a narrow tube heated to a higher temperature, so as to represent the changes which it would undergo on passing up through the non-luminous zone of a flame, the decompositions are somewhat different—no ethane, but methane and acetylene, being formed. Ethylene passed at the rate of 4 to 5 cc. per minute through a tube 2mm. in internal diameter does not undergo any apparent change until the temperature rises to between 800° and 900° C. It then breaks down to methane and acetylene; and, simultaneously with the formation of acetylene, heavy vapours appear, which can be condensed, and in which benzene and naphthalene are conspicuous, as well as a heavy and highly fluorescent oil of high boiling-point. Berthelot found that these substances were formed when acetylene was heated for some time at the temperature at which glass softens; and he also recognized among the products cinnamene (C_8H_8) and retene ($C_{18}H_{18}$). So that there seems very little doubt that, in passing the ethylene through a heated space in which the temperature does not rise above 900°C., methane and acetylene are first formed, and that the latter at once polymerizes into the heavier hydrocarbons. The amount of acetylene found in the products of the experiment rarely exceeds 1 per cent., as the polymerization occurs almost simultaneously with its formation; but the proportion of

ethylene decomposed, and the amount of methane found in the products of decomposition, point to the initial action of heat at this temperature, being—

$$3C_2H_4 = 2(C_2H_2) + 2(CH_4)$$

On increasing the temperature from 900° C. slowly up to 1000° C., the same action continues. No hydrogen appears in the products of decomposition, and no carbon is deposited; but the formation of oil and solid hydrocarbons is more abundant. Between 1000° and 1100° C., a trace of hydrogen appears, and a little carbon begins to deposit with the oil; this increasing with rise in temperature up to between 1300 and 1400° C., by which time all formation of oil has ceased. Carbon is deposited in larger quantities; and the residual gas consists of hydrogen with a little methane. The temperature at which oil disappears is at 1200° C.; and the proportion of acetylene formed at this temperature is larger than at any of the lower ones. It is evident, therefore, that if the temperature existing in the luminous portion of the flame exceeds 1200°C., the luminosity cannot be due to such hydrocarbons as are formed from the acetylene, but that carbon will be present in abundance. I have made several analyses of the carbon so deposited, and find that the hydrogen in it varies from 1 to 3 per cent.; and as there is no fixed ratio, I think there is not the slightest foundation for imagining that it is in combination. Indeed, Stein's work upon this point is fairly conclusive.

Ethane, which is present in illuminating gas in larger proportion than is generally supposed, breaks up even below 800°C. into ethylene and hydrogen, thus—

$$C_2H_6 = C_2H_4 + H_2;$$

and the ethylene behaves as before on increase of temperature. Methane, which is not only present in very large quantities in the original gas, but is also produced during the decomposition of the ethylene, is apparently unaffected by heat until a temperature of 1000°C. is reached, when hydrogen and unsaturated hydrocarbons begin to appear in small traces. Acetylene being the chief of these, this action continues and increases; so that, at about 1500°C., considerable quantities of acetylene are formed, which at once break down to hydrogen and carbon. With methane, as with ethylene, the first trace of acetylene found in the products is also accompanied by the formation of oils and heavy condensable vapours. Methane is not so easily converted into acetylene as the other hydrocarbons; and it requires a higher temperature to bring about the change. But the fact that it does do so at high temperatures fully explains the facts first observed by Dr. Percy Frankland and Mr. Lewis Thompson that, although methane, when burnt by itself, has but a very feeble power of illuminating, yet that, when used as a diluent of heavier hydrocarbons, it greatly increases the light-emitting power of the flame.

Professor Lewes went on to say that, in order to apply the knowledge these experiments give of the changes taking place in the hydrocarbons present in coal gas during their flow through the heated channel in the interior of the flame, it was necessary to map out the temperatures existing in a luminous flame; and the flat flame from a No. 7 Bray burner lent itself conveniently to this purpose. Using a special arrangement of the Le Chatelier thermo-couple, he found that the temperature rapidly rose from 500° C. half an inch above the burner to rather more than 1200° C. at the commencement of the luminous zone—the luminous edges having a temperature of 1216° C.; and these temperatures were further increased in the luminous zone until, near the top of the flame, 1368° C. was reached. This at once gave the secret of the luminosity. From the mouth of the jet and up to a temperature of from 1000° to 1200° C., acetylene was formed from the original hydrocarbons; but the moment the requisite temperature was reached by the combustion of the hydrogen and the carbon monoxide, the acetylene decomposed, with a further rise of temperature, and the carbon, heated to incandescence, radiated heat and light. In the experiments with the hydrocarbons, the gases were passing through a heated space 6 inches long, kept at a constant temperature. In the flame, they were passing through a space 1·75 inches long, with a rapidly increasing temperature; so that, instead of the acetylene becoming polymerized to any great extent, it reached a temperature at which dissociation took place almost as soon as it was formed. Experiments with hydrogen-borne benzene vapour showed that, at a temperature of 1200° to 1300°C., it was reconverted into acetylene; and this then at once broke down to carbon and hydrogen. The same thing happened with any other heavy vapours formed in the inner zone. These bodies, generated probably in minute quantities by polymerization, together with any remaining methane, were reconverted into acetylene, and deposited their carbon as soon as the necessary temperature was reached. This supplied a fresh quantity of carbon particles to the upper portion of the luminous zone, and so increased its size.

Referring next to the careful analyses made by Hilgard, Landolt, and Blochmann, to determine the interactions taking place in various flames, Professor Lewes said they were, in their main features, in close accordance with a long series of analyses of the flame gases which he had himself made; and one of their most striking features was the comparatively slow rate at which the heavy hydrocarbons disappeared, as compared with the other constituents of the original gas. This he found to be due chiefly to diffusion, which caused the hydrogen and methane to find their way to the outer skin of the flame first; and therefore it was these bodies which bore the brunt of the earlier combustion, and yielded the heat which baked into acetylene the heavy hydrocarbons ascending straight upwards from the burner. If three concentric tubes were placed half an inch above an open tube from which coal gas was issuing, and the gas from each was withdrawn and analyzed, it would be found that, on comparing them with the original gas, the action was most marked; the gas contained in the outer tube being practically a mixture of air with hydrogen and methane, while in the inner one the unsaturated hydrocarbons would have risen from 3·56 to 4·53 per cent. The proportion of heavy hydrocarbons consumed before conversion into acetylene and then dissociation into carbon and hydrogen was very small; and the principal hydrocarbon undergoing combustion in the flame was methane. The analyses of Landolt, Hilgard, Blochmann, Smithells, and Professor Lewes himself, all showed that a large increase in the carbon monoxide undoubtedly did take place the higher one ascended in the flame, until the luminous portion was reached. It was also probable, from the same analyses, that hydrogen was generated by some action in the outer layer of combustion; as, in spite of its rapid combustion at the base of the flame, as shown by the large percentage of water vapour formed there, it kept reappearing for some little distance up the flame. It was to explain the joint appearance of carbon and hydrogen that Professor Smithells brought forward his theory that carbon burns to carbon monoxide, setting free the hydrogen from the hydrocarbons. There was not the slightest doubt, from the work done by Dalton, Blochmann, E. von Meyer, and Dixon, that, if gaseous hydrocarbons were exploded with a limited supply of oxygen, carbon monoxide and hydrogen were obtained; and it was also shown by H. H. Baker's experiments that carbon burns first to carbon monoxide. But the lecturer failed to see that any such theory was necessary to explain the actions going on in a flame.

In conclusion, Professor Lewes said: Considering the facts I have laid before you, we may, I think, fairly fully explain the actions that take place in the flame and lead to luminosity. As the gas leaves the jet, the hydrogen rapidly diffuses to the outer edge of the flame, and burns—the methane doing the same, but rather more slowly. The combustion of these gases raises the temperature 500°C. in the first ½ inch; while before another ½ inch has been traversed, 1000°C. is reached, and the chemical changes in the hydrocarbons are progressing rapidly—the unsaturated hydrocarbons and higher members of the saturated hydrocarbons being rapidly converted into acetylene. If the temperature of the flame were not allowed to rise above 1000°C., this acetylene would be nearly all polymerized into benzene, naphthalene, diphenyl, and other complex bodies, which would be slowly burnt up without liberation of carbon; and a non-luminous flame would result. In the case of a gas-flame, however, instead of remaining at 1000°C., the temperature rapidly rises to 1200°C., with the result that, instead of polymerizing into more complex bodies, most of the acetylene formed at once splits up into carbon and hydrogen, and the former, heated to incandescence by combustion, gives the luminosity. It is the attainment of this temperature that marks the limit of the non-luminous zone. If this were the only action, the luminous zone would be very short. The bodies, however, formed from the acetylene before 1200°C. was reached, and the methane of which some still remains unburnt, are converted into acetylene at a still higher temperature—*i. e.*, 1300°C.; and this, being reached near the top of the luminous zone, yields a fresh supply of carbon, and so increases the height of the light-yielding portion of the flame. In producing the luminous flame, therefore, there are two main factors to be observed—first, to use such compounds as shall be most easily converted into acetylene; and, secondly, to attain as quickly as possible as high a temperature as practicable.

AMERICAN GASLIGHT ASSOCIATION.

The Annual Meeting in Boston.

(*Concluded from p.* 904.)

After Mr. Bredel had replied to the questions suggested by his communication, Mr. C. R. Collins read a paper on "The Selection of Anthracites for Water Gas." He said in practice the question was not only how to select the best coal, but also how to get the best results from coal that had been selected for other reasons than that of quality. While the constructive details of generators had been improved almost as far as it was possible to go, there was still too great a tendency to subject all grades of coal to uniform conditions of blast and gas making; whereas these ought to be varied to suit the characteristics of the coal used. The care exercised in analyzing materials and fuels for iron smelting was instanced as affording a lesson for those who work water-gas apparatus. A similar degree of refinement would certainly lead to economy of material and labour. The author had selected 25 specimens of anthracite, ascertained their composition by analysis, and also the results obtained from them under ordinary daily working of a water-gas generator. While he had not yet completed the compilation of the results, he was able to draw attention to some points of general interest that had arisen in the course of his experiments. Referring to the anthracites of

Pennsylvania, from which his samples had been selected, he said that the Lehigh basin was the best in respect to density, hardness, and freedom both from volatile matter and ash. The Schuylkill basin came next; but it was usually dirty—the veins being seamed with slate and earthy matter. The Wyoming basin was softer, and contained more volatile constituents. The mining engineers called an anthracite with one-twelfth or less of volatile matter a hard, dry anthracite; and one with from one-twelfth up to one-eighth, a semi-anthracite. The various sizes in the market, obtainable for generator work, were four—viz., lump coal, steam-boat coal, broken coal, and egg coal. The first consisted of the largest unbroken pieces from the mine; the second, screened through bars from 4 to 7 inches apart; the third would go through a 4-inch, but over a 2½ or 2¼ inch mesh; and the last through a 2¼ to 3¼ inch, but over a 1½ to 1⅞ inch mesh. With regard to characteristics, he preferred hard, dense anthracites, with a dull and imperfect lustre, as being clean in burning, and not liable to splinter. The fire was thus kept open, and uniformity of combustion insured; leaving less waste to be withdrawn at the grate. This kind contained the larger proportion of fixed carbon and the least ash. Coal of approximately cubical shape would give better results than long thin pieces, which packed closely in the generator; and the way in which the charge "packed" was a very important point. In every generator there was at the centre a comparatively inactive portion extending from top to bottom, because the blast would travel with less impediment up the sides, where the coal rested against straight walls, than where each lump accommodated itself to surrounding lumps. This inactive part varied in area according to the size of the coal; egg coal giving 30, and broken coal 15 per cent., while the larger coals left a practically free fire. The size of the coal should therefore receive attention, and be proportionate to the area of the generator. Lump coal was too large for use in generators. Steamboat coal might have some advantage for large generators; but like the former, it could scarcely be handled by automatic conveyors. Broken coal was the best for all purposes, as the egg coal packed too closely. It would be advantageous to arrange to drop the larger lumps at the centre, and throw the small out to the sides of the generator. In any case, all small or slack coal should be separated, and used for other purposes. The specific gravity of a coal increased in a fairly constant proportion with the percentage of ash present; so this was a useful practical test, as, if the density was high, the coal would be impure. While formation of clinker could not be prevented, the heat might be adjusted so as to render its removal easy. A coal yielding ash of a white colour was preferable to one in which the ash was red, as giving a less troublesome clinker.

After the reading of the paper, several questions were put to the author. Mr. Pinkney asked if a uniform time in blasting and making gas was recommended. He said he did not follow this plan, but was guided entirely by the state of the heats. By an overflow from the water-box, he was able to tell at any minute if he was making either lampblack or oil; and from this he could judge the condition of the superheater. So he continued each run as long as the apparatus would stand it. Using a Lowe-Grainger-Collins apparatus, and allowing for waste, &c., his return for last month was 33⅓lbs. of coal per 1000 cubic feet of gas made.

Mr. Collins, in reply, said the maximum percentage of sulphur in the anthracite coals with which he had worked was less than 1. A good gas-house coke, well burned, was equal to the best anthracite for generator use. It was practically all fixed carbon and ash. The best furnace coke was so hard that it required a greater blast to get up the heat; and a softer and inferior coke, not so dense and hard, would be better for the generators. A good coke would not reduce the productive power of a generator as compared with coal, because the fuel bed was more open to the blast. It could be heated up more quickly; and therefore it was possible to make a greater number of runs in an hour. Though so much would not be produced per run as with anthracite, the make per hour would be just as large. Gas coke was worth, weight for weight, as much as anthracite; and there was the additional advantage, in works where coal gas was also made, that it could be taken directly from the retort to the generator in a red-hot condition. With regard to Mr. Pinkney's remarks, he thought that, with well-regulated working, the production of heat per unit of time would be regular, and also the evolution of gas; and therefore he recommended runs of equal length. With the Grainger apparatus, he had worked with from 35 to 45 lbs. of coal per 1000 cubic feet of gas made.

Mr. A. E. Forstall read a paper describing some experiments with different kinds of burners, undertaken with the view of arriving at the most suitable for the gas supplied in his district, which consisted of a mixture of coal and water gas in about equal proportions. The specific gravity was ·570; and the illuminating power about 22 candles. The value of the gas was fixed by adjusting it to burn with a 3½-inch flame-height, in one of Sugg's "D" Argands, having a chimney 7 in. by 2 in., irrespective of the actual consumption per hour, and by calculation reducing the observed results to 5 cubic feet consumption. Each burner was tested at 5-10ths, 7-10ths, and 10-10ths, pressure; and the results are not stated as observed, but in their proportionate value as compared with the standard=100. The small sizes of Bray's "Special" union-jet burner gave a value of only 60 to 70; but No. 5 and No. 6 were more like 90. Bray's "Special" slit or batswing burner did better; and the "Empire" burner was nearly equal to the standard. Sugg's No, 4 table-top burner, governed, was moderate; but the No. 6 size actually surpassed the standard. Bray's 50-candle batswing showed a value of 110; but some ordinary fishtails and batswings yielded low results. The general conclusion is that small-sized burners will not give anything like the duty of large ones; and that batswings are much better than fishtails. The latter, however, do not become obstructed as the others are apt to do.

Discussion being invited, Mr. N. W. Gifford gave the results of some experiments on similar lines which had been conducted by himself, and which fairly agreed with those in the paper. To make sure of getting the actual pressure at the burner outlet, he fixed his gauge directly to the base of the burner. He said he had operated with mixtures of coal and water gas of various qualities, including 18½, 21, and 29 candle gas; and the richer the gas, the better the result with the flat flames. With the highest qualities, the larger-sized burners did not yield so good an efficiency. Mr. A. S. Miller said that metal tips were not so efficient as the lava; but then they were not liable to stop up. Mr. Pearson had experienced difficulty from this cause; but he found that the substitution of metal tips was a perfect cure. Mr. Forstall, in reply, said that, although the metal tips did not become choked with carbon, they rusted up; and this was just as bad. This difficulty was quite as great to-day as when water gas was first introduced.

A paper on "A Gas Association and Its Members" was read by Mr. W. R. Addicks. As the Engineer of five independent gas-works, he said he had been so impressed by the saving of time and money, and the increased efficiency, obtained by harmony of management, that he proposed to apply this principle to the Gas Managers' Associations in the United States. This might be done by amalgamating all together, with the American Gaslight Association at the head. There should be one central office or head-quarters, and also district offices, each with its distinctive set of officials for each section. In addition to the work at present done, and the objects of these Associations, he would give special attention to the subjects of standards, of practical and scientific investigation, and of recording and publishing the transactions. Each District Association should be so far distinct that members of it need not necessarily also belong to the head or National Association. This proposition would involve, in addition to the usual officers, Committees on Standards and on Investigations, and a paid recording Secretary and Librarian, devoting all his time to the service of the Society, at the head office; while the duty of Editor of the Journal of Proceedings might be given to the Secretary. Each District Association would require an official reporter; and their Secretaries might be responsible for the transmission of reports to head-quarters. There would also be Committees as at the central office, working in connection with them, and to some extent under their control. The author concluded by enlarging on the importance of standards, investigations, and official publication of the proceedings.

Mr. C. J. Russell Humphreys opened the discussion by expressing high appreciation of the paper, and hearty sympathy with the scheme propounded in it. He said that some three years ago he read a paper before one of the District Associations on a similar subject; and he was pleased to find the author in agreement with him on several of the points he then raised. He had felt that a great deal of the work done at Association meetings was merely repetition; and consequently the results obtained were not commensurate with the amount of labour. A subject was taken up and discussed, and then thrown aside in an unfinished state; whereas he would like to see it carried a decided step in advance, so that when this particular matter was returned to at the end of a year or two, it could be taken up where it was left, without going back to the beginning. With a broader and wider organization, as suggested, and a greater degree of co-operation, it would be possible in each year to work at least one subject up to some decided result or step in advance. Leakage, for example, was a matter which had been traversed again and again, but with no definite result. Mr. C. A. White agreed with the importance attached to the subject; and he proposed that the paper be referred to the Council, with instructions to thoroughly investigate and report upon it at the next meeting. He also agreed that there was a great deal of useless repetition of elementary matter at these meetings; and the questions raised were frequently left in an unfinished state. A proper Committee might take them in hand, and bring them up to date, or place them in a good form for publication. The proposition was seconded by Mr. Neal, and carried. After this the discussion on the paper was resumed by Mr. A. E. Boardman, who spoke of the important work that might be done by a Standards Committee, and supported the author's recommendations. Mr. M'Donald pointed out that a standard meter-union had been decided upon by the Association a few years since; but that it was difficult to get it generally introduced. Very few gas companies would undertake even the slightest trouble or expense in the adoption of a standard. The meter companies had spent a great deal of time and money on the matter; but the result was a failure. If standards were decided upon, they could not be introduced without expense. Mr. A. C. Humphreys thought it must be admitted that the argument urged by the last speaker was correct; but at the same time he

considered that Mr. Addicks's scheme, if carried out, would prevent such failures in future. Gas managers' meetings might be likened to a steam-engine, in which the efficiency was small and the waste large. Mr. Addicks came forward, as a competent engineer, with a scheme to improve efficiency, which he (the speaker) quite approved. Dr. Amory thought that any action taken by the Council should be supported by the co-operation of the District Associations; and he moved a resolution authorizing them to confer with those societies on the subject of the paper. Mr. C. H. Nettleton having seconded the resolution, it was carried. Mr. Addicks, in reply, said that the meter-union question was the hardest job of all with reference to standards, as it involved a change throughout the district. He was inclined to lay more stress upon the question of standards than on that of investigations.

After the discussion on Mr. Addicks's paper, several matters of business were dealt with. Among other things, a Special Committee of three was appointed to consider the present low prices received for tar, and endeavour to ascertain if anything could be done, by concerted action on the part of gas companies, to increase them. A great diversity of opinion prevailed as to the advisability or otherwise of having the next meeting of the Association at Chicago. After a long discussion, in the course of which several members spoke in favour of holding it at neighbouring towns, on account of the difficulty of getting accommodation, &c., during the period of the World's Fair, a vote in favour of Chicago was carried.

A paper on "Water Gas Condensation" was read by Mr. John M. Rusby, who spoke of tarry matter in the crude gas as suspended liquids which had never assumed the gaseous condition, even at the greatest heat to which they had been exposed; and he insisted on the importance of removing them at a high temperature, on account of their affinity for the illuminating vapours. Having noticed the difference between permanent gases and vapours, and the laws which govern the retention of the latter in the gas, he said that any considerable quantity of liquid deposit showed lack of proper "fixing." In his own experience, using the Lowe process and naphtha as an enricher, the total production of tar or oil did not reach 0·5 per cent. of the quantity of naphtha employed. Although the gas, leaving the superheater at 700° to 1000° Fahr., was reduced suddenly to perhaps one-fifth of this by passing the hydraulic seal, he did not think it was seriously prejudiced, provided the temperature was not reduced below 125° Fahr. M. Alavoine, a French gas engineer, had inserted a small Pelouze and Audouin condenser at the dip; and, using a liberal supply of water, he had reduced the temperature to 80° Fahr., and extracted 90 per cent. of the tar. This was with coal gas; and, after prolonged experiment, it was found that the quality of the gas was not injured. This was more severe treatment than any experienced in water-gas apparatus; but it should be observed that the tar was carefully preserved from any subsequent contact with the gas. He advocated treating the gas, while at a high temperature, with crude tar. By this means all the lighter constituents could be passed into the gas, and nothing but pitch left. A temperature below 700° Fahr. would be ample. Although water was active as a cooling agent when brought into contact with the gas, and had but little, if any, absorptive effect on it at temperatures above 80° Fahr., he preferred dry condensation, yielding a tar free from water. Water might be applied externally; and the hot water so obtained could be utilized to feed the boilers—thus securing some economy in fuel. It was not at all necessary to wash the gas; and many engineers found it advantageous to dispense with this operation.

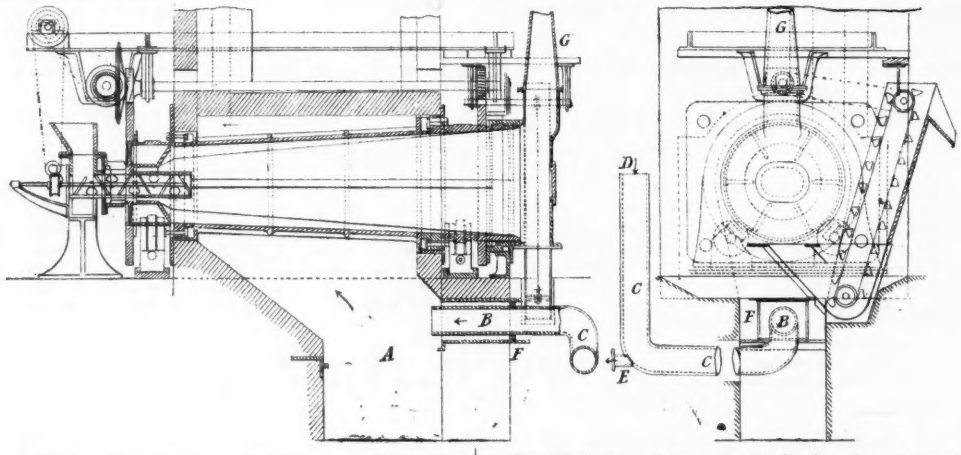
A paper entitled "Do Small Gas-Works need Consulting Engineers?" was read by Colonel C. A. White, who answered the question in the affirmative, on the ground that, while they could not afford to retain the services of a skilled gas engineer, it was none the less necessary for them to have the advantage of first-rate plant, &c. As a manager, they needed a common-sense all-round man who could look after each department; but it was necessary that they should fall back on some experienced person, who could command their full confidence, for advice as to the best and most economical methods of conducting the works, and making repairs or extensions of plant.

The contents of the "question-box" were rapidly disposed of, after which votes of thanks were passed to the President and Secretary, and the business of the meeting terminated.

REGISTER OF PATENTS.

A Revolving Gas-Retort.—Yeadon, J. A., and Adgie, W., of Leeds. No. 22,292; Dec. 21, 1891.

This invention is partially connected with a previous patent of 1889, No. 19,183; and it consists of an improved method of heating the revolving retorts therein shown, or any other retorts to which it may be applied. Alluding to their present proposal, the patentees say: "In the description of our revolving retort, as contained in the above-mentioned specification, we show it as suitable for being heated by a coke fire underneath, as in the ordinary method at present used in gas-works, which system necessitates the employment of firemen for working the same. Our present invention has for its object the dispensing altogether with a coke fire underneath as at present used, and also with the necessary labour of the firemen for tending the same, by substituting the use of gas of any suitable description for the purpose—either alone, or mixed with any suitable quantity of air for combustion, as may be found most advantageous; the heating of our retort being thus effected automatically and continuously, instead of intermittently, as in the present systems where coke is used for the purpose."



The illustration shows a longitudinal section of the retort, with the plan of feeding the coal into the retort, carbonizing the same, and discharging the spent cinders; as well as a back elevation of same at the end where the gas and air enter into the combustion chamber for heating the retort.

To carry out their invention, the patentees propose to make a connection with any pipe containing gas suitable for the purpose, whether it be the gas usually produced at gas-works, or water gas, or any other kind—preferably that usually produced in gas-works. They also prefer it "crude and unpurified, as containing more heating properties." For this purpose, the connection for the gas to be used is made at any point of the ascension-pipe G, between the retort and the hydraulic main, as the gas thus obtained is considered most suitable for the purpose. Underneath the retort is built or erected a combustion chamber A, which can be fitted, if required, with fire door and frame F; also adjustable and regulating valves for the admission of the air and gas separately, or for the air and gas previously mixed together in the proper proportions for satisfactory combustion and heating. If the gas is already mixed with air in the proper proportions for heating the retorts, the regulating-valves in or near the furnace-door are dispensed with, and the arrangement is as follows: Through the centre of the fire-door F is inserted a pipe B, extending a little way into the furnace itself. To this is connected a pipe C, continuing (say) some 20 or 30 feet from the fire-door, and open at its other end D to the atmosphere. It has a valve at the inlet end for regulating the admission of the air as required. Within a few feet of this, a pipe E (of a smaller diameter) is attached to the pipe containing the gas to be employed. This pipe is also fitted with a valve or tap to regulate the quantity of gas required to be used. The furnace is so constructed that no air or gas can enter into the combustion chamber, except through the fire-door F. The continuous action of combustion draws the air and gas through this main feed-pipe C into the combustion chamber A; the regulating-valves adjusting the proper quantity and proportion of air and gas found most suitable for combustion and heating, and which become mixed together as they pass through the main feed-pipe C into the combustion chamber A.

If found desirable, say the patentees, the gas can be arranged to be fed with sufficient pressure direct from the ascension-pipe G, or passed through a suitable exhauster as required to suit different cases; their opinion being that crude gas is the most efficient for the purpose. Also the invention can be used by a combination of the above with any ordinary coke fire, by admitting the gas, or gas and air, over or through the coke fire in the combustion chamber, for the purpose of generating the temperature necessary for heating the retorts.

Concluding their account of the invention, the patentees say: We are fully aware that gas of various kinds, crude or otherwise, has already been adopted in a variety of ways for heating purposes; but, so far as we know, it has not yet been used in any form for heating revolving retorts for the distillation of coal or any other analogous

purposes, nor has crude or water gas been used for heating either revolving or fixed retorts. Our present invention is therefore, in the first place, for using any kind of gas for heating revolving retorts; and in the second place, for heating any retorts fixed or revolving with crude (*i.e.*, unpurified) gas, or with water gas, either with or without coke fires, so as to reduce, or altogether dispense with, the labour of the firemen, and to secure a more uniform and regular temperature in the retorts than can be obtained with the present system of heating.

Gas-Fittings.—Anderson, T. R., of Dundee. No. 22,662; Dec. 29, 1891.

This invention in gas-fittings (its object being to lessen the waste of gas, specially applicable to the lighting of offices, workshops, and the like) consists in applying a valve to the gas pipe or cock in such a manner that, by simply giving it a slight push, the light is lowered the requisite amount, without having to touch the key.

Applied to an elbow cock, universal centre joint, or the like, the valve is preferably at the elbow or corner immediately past the key—that is to say, the gas, after passing the key, proceeds past the valve in a direction parallel to its axis. The valve-spindle travels out through a suitable stuffing-box, and terminates in a knob. When the knob is fully out, the valve is open, and the gas is free to pass to the burner without obstruction; but when the knob is in, and the valve on its seat, only a small quantity of gas can flow through the bye-pass. In order that there may be little danger of the bye-pass being choked, it is made to terminate in a groove in the valve instead of coming directly to the spindle. In a modification suitable to pillar cocks and the like, the valve is applied to the key; the axis of both coinciding. When the valve is open, the gas flows through the key in the ordinary manner; but when it is closed, it passes at right angles to the axis of the valve, through a small groove or channel in the valve itself.

Supplying Heated Gas and Air to Boiler Furnaces, &c.—Nicholson, T. and E. T., of Colwyn Bay. No. 247; Jan. 6, 1892.

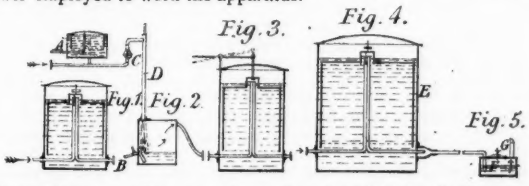
These improvements consist in heating both the gas and air before using, and in supplying the latter (so as to get complete combustion) in considerably greater quantity than the former, without materially increasing the size of the flues or pipes required to carry it. The gas and air obtain their heat by being passed first under the furnaces of the gas-producers, or other suitable structures; and then under, alongside of, or over the radiated heat of the furnaces or places in which they are to be consumed.

Where practicable, small steam-jets are introduced to give both heat and velocity. To obtain the greater quantity of air, a small air-blast is used in such a way as to act as an injector. Where the fires do not occupy the whole base of the gas-producers or other structures, a false roof is put in; and thus the heat is caused to distribute equally over the whole area.

The steam-jets can be of any number, and be placed in any position found to be most desirable to facilitate the progress of the gas and air along the heating-flues. For supplying hot gas and air to other than boiler furnaces, it is necessary to somewhat vary the arrangement of the flues—carrying them underneath the structures which get their heat in or from the bottom, and alongside, under, over, around, or through the radiated, waste, and effluent heat of those having their fires in the body, ends, sides, or top. Gas retorts and producers, brick, pottery, lime, and calcining kilns, puddling, melting, and annealing furnaces, furnaces for salt pans, drying-sheds, and other purposes are available; but the fundamental method of carrying out the invention is the same in all.

Making and Storing Inflammable Gas and Air.—Beck, W. H.; communicated from B. de Lissa, of Melbourne. No. 15,122; Aug. 22, 1892.

This invention consists in mixing atmospheric air with any inflammable gas, "thereby increasing its bulk and efficiency," and the employment of "novel appliances to obtain the desired result, and in the mechanism being so arranged as to automatically govern the motive power employed to work the apparatus."



From the source of gas supply, a pipe A is led terminating in an automatically worked governor valve, whence the gas is allowed to proceed into a small water-sealed chamber. From this chamber, a small pipe meets a larger air-supply pipe B. This pipe comes from an apparatus constructed as in fig. 1. Here in an upright tank is a floating pontoon, made somewhat of a gasholder shape, and weighted at its upper end. On a spindle is also fixed a hanging valve, placed in an upright pipe, and so arranged that, when the pontoon rises or falls, the valve shuts or opens in a corresponding measure. The interior of the tank is filled to a convenient height with water, so as to form a seal. The pipe B, after being joined with the exit from the first-named vessel, terminates in a retention valve-box C, in which is set a lift-valve, arranged to prevent any return of fluid. This valve-box is connected in its turn by means of a pipe bend with a vertical water-blast tube D, through which a jet or shower of water is made to fall, and which terminates at its bottom in a tank (see fig. 2). Near the bottom of the tank, is a small escape-pipe and air-tube, arranged to allow the water at the bottom of the tank to retain a constant level, and thus prevent any escape of gas. From the top of the tank, the mixed gas and air are led away into a larger receptacle, in the interior of which is a balanced water gasholder, shaped at the top with a hood to cover the inlet and exit pipes, and so designed as to obviate as far as possible any large quantity of gas from collecting therein. To the top of the hood is affixed a bifurcated rod or equivalent, centred to a rocking lever, at the far end of which controlling gear is arranged in such a manner that, when the waterholder rises or falls, the rocking lever acts reciprocally on the valve gear of the water supply or engine operating the blast D.

Referring now to fig. 4, the pipe from fig. 3 enters another pontoon gasholder somewhat similar to that in fig. 1, and from the hood of it another pipe descends and terminates outside the tank. The bottom end of this pipe is closed in with wire gauze, and is surrounded with an enlarged closed chamber. From this latter chamber, the gas is again led away through a pipe, either direct to the point of consumption or first (and preferably) through a small water-tank (fig. 5). In this tank the gas enters at the bottom, and, after bubbling up through the water, escapes into a lead-away pipe to be consumed. On the top of the tank F is a weighted safety-valve, which can be set to any predetermined resistance.

The method of mixing the air with the gas and the working of the apparatus are as follows: The water-blast in D is set going; thus causing a rush of air to take place in the various pipes, and a vacuum in the small pipe attached to B, and bringing down the cover of the bell arrangement. The cover in its turn opens the inner valve; thus permitting a rich gas to flow into the chamber, and thence down to mingle with the air in the pipe. The mixed gas and air proceeds under the lift-valve C, downward through the tube D, into the tank shown in fig. 2. Here the water falls to the bottom, and runs away from a predetermined height by a syphon pipe. The mixed gas, on the other hand, rises to the top of the chamber, and proceeds to fig. 3 and fills in the space in the hood, and then travels down along and up the pipe into the gasholder E (fig. 4). From thence it again escapes through the wire gauze mouth into the tank F; and so is led away to wherever desired. Should an undesirable pressure of gas accumulate in this tank, the safety-valve G will come into operation and permit its escape. The water is placed in the tank F for the dual purpose of cleansing the mixed gas, and preventing any flame or sparks finding their way into the gasholder; and for a similar purpose the wire gauze is placed after the chamber E.

APPLICATIONS FOR LETTERS PATENT.

21,737.—Lindley, H., Browett, T., and Gibbons, F. C., "Motive power engines actuated by steam or other expansible and condensable gas." Nov. 29.

21,752.—Johnstone, J., "Self-generating gas or vapour burners applicable for lighting or heating purposes." Nov. 29.

21,775.—White, W., "Regenerative gas-lamps." Nov. 29.

21,809.—Epstein, G. J., "Treating pitch or tar and like residues resulting from the manufacture of oils or fats or wax, or from gas or the like." Nov. 29.

21,819.—Carter, G., "Coin-freed gas-meters." Nov. 29.

21,841.—Weyman, J. E., Hitchcock, G., and Drake, J. A., "Gas and oil engines and other hydrocarbon motors." Nov. 30.

21,871.—Fourness, H., "Valves and apparatus employed in the manufacture of illuminating and heating gas." Nov. 30.

21,917.—Wetter, J., "Igniting the combustible charges or gas mixtures of gas and oil engines." A communication from J. Rademacher. Nov. 30.

21,934.—Stutley, J. S. P., "Incandescent burner for hydrocarbon gas." Nov. 30.

21,937.—Mooney, A., jun., "Gas-valve or cock." Nov. 30.

21,999.—Brendel, E., "Combination lamp for lighting, warming, and boiling purposes." Dec. 1.

22,033.—Thomas, T. C. J., "Regenerative gas-lamps." Dec. 1.

22,079.—Shoubridge, S. Y., "Charging gas-retorts." Dec. 2.

22,095.—Newton, H. E., "Firing retort-benches with gas." A communication from R. N. Oakman, jun. Dec. 2.

22,096.—Newton, H. E., "Gas-fired retort-benches." A communication from R. N. Oakman, jun. Dec. 2.

22,174.—Newton, H. E., "Gas-producing plant." A communication from R. N. Oakman, jun. Dec. 3.

Grand Junction Water Company.—The report of the Directors of this Company to Sept. 30 last recommends a dividend for the last half year at the rate of 8½ per cent. per annum on the ordinary share capital, of 7½ per cent. per annum on the £25 "C" shares, and of 7 per cent. per annum on the £50 "D" shares, together with dividend and interest, in accordance with the conditions of sale, on the 600 new £50 "D" shares issued on July 6 last.

Suggested Abolition of Gas-Meter Rents at Rotherham.—A recommendation of the Gas Committee, that the gas-meter rents should be abolished at the end of the present financial year, was discussed by the Rotherham Town Council last Wednesday. The rejection of the proposal was moved by Mr. Winter, who contended that the advantages of the change were all imaginary; but the disadvantages were real, and would prove a very serious matter to the ratepayers and the Corporation. The charges had not been exorbitant or unjust. The total number of meters in the possession of the Corporation was 3918, valued, after deducting £2211 8s. 6d. for depreciation, at £4002. The revenue derived from meters was £619, or nearly 10 per cent. on the cost; but after deducting £216 13s. 11d. for repairs and £310 14s. for depreciation, the net revenue to the Corporation from meters only amounted to £91 12s. 1d., or 1½ per cent. The money loan upon the gas-works was a mortgage not upon the works, but upon the property of the town, and the ratepayers as a whole were responsible. Assuming that they were going to get an increase of 3000 customers, would the gain more than compensate for the loss? At the present price of gas and of manufacturing it, that would certainly not be the case. Past experience taught them that they were not likely to gain so many customers. The proposition meant that £619 would be swept away from the coffers of the gas-works, and £619 would be taken away from the sum usually applied to the reduction of the rates, and this represented a reduction in the rates to the extent of 1¼d. in the pound. He was told that an expenditure of no less than £10,000 on the gas-works would have to be met next year, and that the raising of it would be by a loan of £6000 and the payment out of revenue of £4000. A discussion of about two hours' duration followed; and at its close, eight votes were recorded for the recommendation, and ten in opposition.

CORRESPONDENCE.

[*We are not responsible for opinions expressed by correspondents.*]

Sunday Labour at the Leicester Gas-Works.

SIR,—Upon reading the evidence, as reported by you in your last issue, of Dr. Gritton upon the above subject before the Labour Commission, I was considerably astonished at the reason given by the reverend gentleman as coming from me for our continuance of Sunday labour in the carbonizing department—viz., that "I thought it good for the men that they should not be entirely thrust out of their usual work, and be loitering about with nothing to do."

The facts with reference to Dr. Gritton's visit to Leicester are these: On Saturday morning, Nov. 15, 1890, he called upon me at the town offices with reference to this subject. The result of our interview was correctly stated by the reverend gentleman himself when preaching the next morning at Christ Church in this town. He then informed his congregation of the great pleasure he had derived from his visit to me, and the sympathy I had expressed with the objects of his Association; and he was glad to be able to inform them that I had a hope of the possibility of being able eventually, upon the completion of the works at Aylestone Road, to further reduce, if not entirely suspend, Sunday labour. As I cannot for a moment suppose that Dr. Gritton was drawing upon his imagination when making his statement before the Commissioners, I can only infer that, from some confusion in his notes, he has attributed to me an expression gathered elsewhere. I trust, therefore, that my loss may be some one else's gain.

ALFRED COLSON, Engineer and Manager.

Gas-Works, Leicester, Dec. 10, 1892.

SIR,—In giving evidence before the Labour Commission on the 29th ult., I stated some matters touching gas working on Sundays. You have printed my evidence, and have also made remarks thereon. I am exceedingly sorry to inform you that, in a moment of confusion, I have done injustice to Mr. Colson. I have correctly stated the facts as to the character of the Leicester works, and as to the amount of Sunday work at the date of my visit; but I have attributed to Mr. Colson a reason for the Sunday work which he did not give, and which was given me elsewhere. It is only just that I should express my deep regret for the very serious blunder I have made, which has troubled a worthy man, and has misled yourself.

I have asked the Labour Commission to recall me, so that I may confess my mistake; and I have also corrected it in the proof of my evidence which has been sent to me before printing off.

JOHN GRITTON.

12, *Culmington Road, Ealing, Dec.* 9, 1892.

Purification.

SIR,—Mr. C. C. Carpenter, in his letter in your last issue, gives fuller and further information on "Purification" than could be gathered from his original paper. In his "Cycle of Purifiers" table no one could learn that there were more than about 370 grains of sulphuretted hydrogen per 100 cubic feet at the inlet to the purifiers. Now we are told the sulphuretted hydrogen varies between 750 and 940 grains. It was impossible to ascertain this by studying the table; and anyone consulting it in after-years will be probably misled.

Mr. Carpenter says that I do not quote him quite correctly in stating that he recommends the admission of 1 per cent. of air to the third or fourth purifier, in order to remove the carbon disulphide from the gas. I can only say that I gave his own actual words and figures, and took them to mean just what they stated.

Mr. Carpenter declares that there is a waste of oxygen when air is admitted before the exhauster; and that if any oxygen of the 1 per cent. of air does reach the first box, it is "nearly always wholly absorbed therein." If this is the case at Mr. Carpenter's works, his experience differs very much from what is found at other places. Experienced analysts, using suitable apparatus for determining small quantities of oxygen, do not find that this gas is nearly always wholly absorbed before the first purifying-box is passed. The analyses of coal gas by Professors Roscoe, Frankland, and Vivian B. Lewes, Dr. Thorne, Mr. G. E. Davis, and others, show that no inconsiderable proportion of the oxygen added to, or accidentally present in, the crude gas, may and does pass not only through the first lime box, but the whole of the purifiers, and is ultimately found in the finished gas. The results obtained at Rochdale are also of this description.

It is interesting to note that, since Mr. Carpenter read his recent paper, in which he advocated the forcing of 1 per cent. of air into the third or fourth purifier in order to absorb the carbon disulphide, he has discovered that nothing like this quantity of air is really required for the purpose. Mr. Linging, however, stated this to be the case a week previously. This confirms what I said on this point in my letter a fortnight ago. With further observation, it is very likely that Mr. Carpenter will come to the conclusion that no added air at all is necessary, as he will doubtless find sufficient oxygen always present in the crude gas to meet the supposed infinitesimal requirements of the carbon disulphide. Especially may we anticipate this, now that he has also discovered that the cold clean water, used in the scrubbers for removing the last traces of ammonia, gives up sufficient oxygen to the crude gas to allow of an efficient sulphide purifier being directly formed. With the greatest respect, however, for Mr. Carpenter's work, I must say that I do not believe in the *cold* water giving up its exceedingly small quantity of oxygen, which it holds firmly in solution, to the crude gas receiving its final washing.

With regard to the efficient working of a sulphide purifier, Mr. Carpenter replies to something I never questioned, but leaves unnoticed what I did say, except that he reminds me that equations have their use and misuse, and that the results of Veley's careful and quantitative work on the formation of calcium sulphides and their power to absorb carbon disulphide were not given to the public dogmatically, or as possessing infallibility. The results are certainly no worse for that, as dogmatism and an air of infallibility are no guarantee of accuracy. In his paper on "Purification," Mr. Carpenter distinctly said that the sulphides of calcium were totally incapable of arresting carbon disulphide, unless a certain proportion of air was added, or unless the sulphided lime was occasionally exposed to the atmosphere. All this was apparently meant to imply that oxygen was an essential element in any reaction between sulphided lime and carbon disulphide. Hence his statement about proportioning the air to the quantity of this sulphur compound, &c. I asked Mr. Carpenter if he could give any reasons for this doctrine. None, however, are forthcoming. Nor is it possible, in my opinion, to give any which will bear examination.

In my letter I never stated that a sulphide purifier did not become more active when the contents were broken up and exposed to the air. Every feebly acting lime box so treated becomes more efficient for the absorption of both carbonic acid and sulphuretted hydrogen, as well as for the carbon disulphide. With a sulphide purifier, this renewed activity is, I believe, very largely due to the fact that, when the lime is broken up, the enclosed (or crusted over) sulphides become liberated and freely exposed to the gas when the box is again put into action, with the result that carbon disulphide is again readily absorbed. Anyone who has chemically examined foul lime will know what a large amount of active matter there is locked up in the so-called spent material. This is what might be expected when one considers that the solid lime remains at rest in the purifiers.

Whether or not the sulphides of calcium which have not been exposed to the air, and which have no air supplied to them, will take up carbon disulphide may be put to the test at any gas-works where the purifiers consist of four oxide of iron boxes followed by two lime boxes. Here the purified gas will probably contain between 30 and 40 grains of sulphur in compounds other than sulphuretted hydrogen, and a portion of the gas may be sent through an experimental sulphide box, and then through one of oxide of iron. A determination of the total sulphur in the gas before and after these two boxes will tell whether the sulphides of lime alone are "quite useless for absorbing carbon disulphide."

THOS. STENHOUSE.

Rochdale, Dec. 9, 1892.

SIR,—I presume Mr. Moss, in his letter in the last number of the JOURNAL, refers to the improvements made by Mr. L. Mond, by which bleaching powder can be produced as a bye-product of the ammonia-soda, as well as by the Leblanc process. The use of Weldon mud (in conjunction with lime) does not, however, involve any re-arrangement of purifiers; so that these are equally available for it as for oxide of iron. The economy of using the mud depends upon its price; and if this is prohibitory, oxide would have to be reverted to.

As regards the interposition of oxide of iron in purifying with carbonate and sulphide vessels, I find that, in the correspondence following Mr. H. E. Jones's paper read before the Institution of Civil Engineers, it is stated that this plan was first adopted by him in 1877 at the Ratcliff Gas-Works.

C. C. CARPENTER.

Vauxhall, Dec. 10, 1892.

Regenerative v. Ordinary Settings.

SIR,—I notice that a discussion is still going on in the columns of the JOURNAL on the relative merits of ordinary and regenerator retort-settings. I thought that this question had been decided years ago, in favour of the latter.

My experience with regenerative settings has led me to fix the economy effected in consumption of fuel as follows: An ordinary setting of the old type requires 5 cwt. of coke for every ton of coal carbonized; and a regenerator setting consumes for the same amount of work, 3 cwt. of coke. There is, therefore, a saving of two-fifths of the fuel formerly consumed.

A regenerator setting to effect this economy must be of a complete character, with full-depth furnace descending 8 to 10 feet below the charging floor; and it must be provided with an adequate arrangement of regenerating flues and air channels, which will prevent the waste gases from entering the main flue at a high temperature. The extra cost of such regenerator settings is about £10 per mouthpiece.

G. E. STEVENSON.

Manchester, Dec. 7, 1892.

SIR,—The yield of coke from Pelton Main coal may, as your correspondent, Mr. D. Irving, avers, be a side issue of the above subject, and of itself of little moment. But Mr. Irving must not forget that he himself adduced it as the main factor of his exposition of Mr. W. J. Latchford's figures in his letter dated Oct. 28; and it is certainly due from him to clear up an involved point, which is a difficulty of his own creating.

But granting that the coal in question may be made to produce 48 bushels of coke, let us see what the actual gross weight of this number of bushels would amount to. On turning to Mr. Newbigging's "Handbook" (5th ed., p. 369), I find the following: "A chaldron of coke varies in weight from 12½ to 15 cwt." As a chaldron contains 36 bushels, then the weight of 48 bushels would be, "on a low estimate, from 16 to 17 cwt., or a return of between 80 and 90 per cent.;" or, to strain a point and assume the chaldron to weigh the higher figure—viz., 15 cwt.—a return of exactly 20 cwt. per ton of coal carbonized, or 100 per cent., which is a *reductio ad absurdum*, or, as Mr. Irving naively remarked of one of his suppositions on Mr. Latchford's fuel account, a result "worth recording."

It appears to me now that we can only regard Mr. Irving's figures as simple approximations; and their value practically *nil*. So that our present position is still very much the same with regard to Mr. Latchford's remarkable fuel account as it was before Mr. Irving kindly undertook to enlighten us upon it. But perhaps I am still venturing upon "erroneous suppositions." If so, Mr. Irving can very easily dispel them; but may I remind him that *platitudes* do not help a discussion of this kind any "forrarder."

Although this is hardly the place to discuss the ethics of adopting a *nom de plume*, I may say I am not aware that in so doing I have violated any of the canons of etiquette. I fancy the matter is purely one of personal inclination—some people like to view their patronymic in print, others do not.

SANCHO PANZA.

Dec. 10, 1892.

Gaseous Explosive Mixtures in Tar-Tanks.

SIR,—The recent explosions in tar-tanks would seem to indicate that the primary cause of such disasters is not thoroughly understood and provided against. When they do occur, but little is left on which to form an opinion as to the antecedent conditions of the atmosphere of the tar-well. That there was an explosive mixture goes without saying. The question arises: Was the explosive mixture due to coal gas, or to vapours arising from the tar, or to a mixture of the two? Some experimental evidence on these points is clearly needed. The only experience I have had was in connection with the Dorchester explosion in November, 1879. Since that time I have come to the conclusion that it would be possible to determine how far the atmosphere of a tar-tank is contaminated with coal gas, or with vapours arising from the tar. A mixture of the two could not so easily be identified. As circumstances have abundantly proved, there is an explosive mixture *occasionally* existent. Are tar-tanks liable to contain gaseous mixtures, the explosive nature of which is not suspected for the simple reason that they are not fired? In the interests of the proprietors of gas-works, and all concerned in their working, the matter appears to be one worthy of serious attention and systematic inquiry.

Middlesex Hospital, W., Dec. 8, 1892. W. FOSTER.

The Ulverston Gas-Meter Dispute.

SIR,—In the case reported in the JOURNAL for the 22nd ult., it is stated by a meter inspector appointed under the Sale of Gas Act that, by reason of some defect in the Act itself, the proper quantity of gas might pass through a meter, while, there being some defect in the index, that quantity might not be registered correctly; and that a meter stamped under such circumstances would nevertheless be a compliance with the Act. I have looked over the Act again and again; and, although it is almost smothered with useless verbiage, I cannot find anything to justify the interpretation put upon it by the meter inspector. I shall therefore feel obliged if you will permit me to make a few remarks upon it. It may, however, be well to state at once that, from the first, this has been considered a question more for gas-meter makers than for gas companies.

The Act provides (in substance) as follows: After the passing of the Act, the only legal standard or unit of measure for the sale of gas by meter is to be the cubic foot. No meter is to be stamped which shall be found by the inspector to register quantities varying from the true standard measure more than 2 per cent. in favour of the seller or 3 per cent. in favour of the consumer. Every meter, whether stamped or unstamped, which shall be found by such inspector to register quantities varying beyond the limits aforesaid, shall be deemed incorrect within the meaning of the Act; and every meter which shall be found by such inspector to measure and *register quantities accurately* within the limits aforesaid shall be considered *as correct*, and be stamped as aforesaid. An inspector duly appointed may, after 24 hours' notice, enter any premises where gas is consumed, to examine and *test any meter*, and, if necessary, to remove the same. It is also specially provided by the Act that no maker, repairer, or seller of meters or of gas shall be an inspector appointed under the Act; and that all meters required to be tested shall be delivered to the inspector at the place where his testing gasholder and apparatus may be kept.

The Act is a Public Act, and, as such, is binding upon all persons selling gas by meter, whether or not it is incorporated in their Special Acts, or whether such persons supply gas under Acts of Parliament or not.

In every Act of Parliament passed for the purposes of measurement, there must, of necessity, be some definition of the "unit of measure;" and the provisions in this Act requiring the meters not to vary in their registration more than 2 per cent. in favour of the seller, or 3 per cent. in favour of the buyer, is nothing more than a definition of the unit in this case, and has no force in itself. The Act provides for models of the cubic foot, with multiples and decimal parts thereof, being verified by the Treasury before being used for these purposes, and for inspectors to be appointed by Quarter Sessions to test meters with the apparatus verified as aforesaid, and also for settling disputes as to the registration of meters in case of dispute.

In the event of any consumer disputing the registration of his meter, and wishing to have it tested, it should be taken down by the company and sent direct to the inspector of the district where the testing apparatus is kept, and be there left, with instructions for him to test it for the entire quantity in dispute, and to give his certificate accordingly when he had done so. If the entire quantity was (say) 10,000 cubic feet, and the inspector was instructed to test for 11,000 cubic feet, to prevent the exact quantity being known, his certificate that the second quantity had been tested and found to agree precisely with the quantity registered immediately preceding it, would place the question as to the quantity actually consumed beyond all dispute. No certificate can be of any use, unless it is given by an inspector officially appointed under the Act, and, if necessary, that the meter had been tested with the apparatus appointed by the Act for that purpose, and that the meter, on being removed from the consumer's premises, had been sent direct to the inspector of the district where the gas had been consumed.

As meters may be tested by air as well as by gas, this need not increase the expense; but, as it would occupy much more time, in certain cases a special fee might be paid for the purpose.

76, Palace Chambers, Westminster, S.W., Dec. 10, 1892. W. LIVESEY.

Automatic Arrangements for Putting Gas-Burners In and Out of Use.

SIR,—The arrangement for extinguishing gas-burners referred to on p. 995 of the last issue of the JOURNAL is by no means new. It has been applied for at least 20 years to steam vulcanizing boilers for dentists' use. I have myself made several, using a long needle pointer on the gas-tap, which was connected by a cord and pulley to a common American alarum clock; the pulley being fixed on the winding square of the alarum, which, at the right time, turned the gas out and rang the bell. It is a very simple arrangement, and one which, for this special purpose, leaves nothing to be desired, except perhaps that the clock will keep in order, and go off at the right time—a result not always to be depended upon, while American alarum clocks are made at the price they are at present.

Warrington, Dec. 8, 1892. THOS. FLETCHER.

Silencing Gas-Engine Exhausts.

SIR,—Having observed, in your issue for the 6th inst., under the heading of "Notes," an article describing all the dangers and troubles experienced by M. Simon, as described by him in *L'Electricien*, while endeavouring to design an apparatus to effect the very desirable, and in many instances absolutely necessary, operation of silencing the noise caused by the explosive discharge from gas-engines, I have thought it might interest your readers if I described how my patent "Silent" and purifying gas-engine exhaust is being extensively employed for the purpose for which it was designed. In some cases, installations for electric lighting could not be carried out without it, as the nature of the buildings prevent such a thing as a pipe being led up to the roof, and the noise would not be tolerated for a moment if my "Silent" exhaust were not in use; besides, even although silence might be effected without my patented arrangement, the amount of deleterious gases evolved (the engine being generally in a basement) would very soon put to "silence" every individual who ventured down there. By using calcium hydrate in my "Silent" exhaust, not only is the noise conspicuous by its entire absence, but no pipe requires to be led to the roof of any building; and considerable saving in renewing exhaust-tubes is effected. The products from the explosive discharge are allowed, after purification, to mix with the air of the engine-room, and are inodorous and innocuous. A considerable saving of gas is also effected by the piston being relieved of all back pressure, and the exhaust-tubes do not corrode through, and require frequent renewals, as in cases where these have to be led to the outer air. Although gas-engines be running day and night in residential districts, the quiet of the neighbourhood remains undisturbed; and no one would be aware of a gas-engine being near, when my "Silent" exhaust is attached.

WILLIAM KEY,
Ventilating and Heating Engineer.

109, *Hope Street, Glasgow, Dec.* 8, 1892.

The Cast-Iron Tank for the Guildford Gas Company.—Messrs. Henry Balfour and Co., of the Durie Foundry, Leven, Fife, and Victoria Street, S.W., have secured the order for the cast-iron tank for the Guildford Gas Company, for which an advertisement appeared in the JOURNAL a few weeks ago.

Increase of Gas-Stoves at Rochdale.—It is reported that there are now about 2000 gas-stoves in use for domestic purposes at Rochdale. Half of these have been obtained during the past twelve months; and the fact is regarded as evidence of the success of the policy which the Gas Engineer and Manager (Mr. T. B. Ball) and the Gas Committee have followed, of selling gas at a moderate price and encouraging householders to acquire stoves on hire or easy terms of purchase.

Extension of the Gas-Works Needed at Sutton-in-Ashfield.—At the last ordinary meeting of the Sutton-in-Ashfield Local Board, the condition of the gas-works was referred to. The matter came up on the presentation of the minutes of the Gas Committee, which stated that the Chairman had been authorized to obtain the assent of certain owners and occupiers of houses in connection with a contemplated purchase of land for gas purposes. Mr. Allsop, in moving the adoption of the minutes, said he thought that, as a Board, they ought to do all they could to get the required assents; the urgent necessity for increased convenience, if the gas undertaking was to pay, being shown by the last monthly report of their Consulting Engineer (Mr. C. E. Jones, of Chesterfield). After some discussion in regard to the damage caused to gas-pipes by the use of the steam-roller, the minutes were adopted. Mr. Bonsor expressed the opinion that the Gas Committee should meet more than once a month during the present crisis; and he said a thoughtful ratepayer had suggested that the land already belonging to the Board would realize enough, if sold, to pay for what was required. He moved to this effect; but he withdrew the motion, and left the matters as suggestions. In the course of Mr. Jones's report, alluded to above, he stated that, on the 28th ult., he found 15 retorts at gas-making heat lying idle, or (say) half the number at work, in consequence of there being no available storeage for the gas, though the quantity made up to noon was insufficient; being about one-third of the daily requirements. Having before pointed out this wasteful and ruinously expensive method of manufacturing gas—the deterioration of the retorts, loss of gas by leakage, and by the coal being only partially carbonized owing to the need of producing a large quantity of gas in a short time, &c.—he said he would be pleased to see more plant provided without delay, since it was impossible to manage on economical principles the undertaking as it now exists. Chemical tests showed the presence of impurities in the gas—sulphuretted hydrogen and ammonia being abundant; and this could not be helped under the existing conditions. The ammonia doubtless could have been largely reduced if his former recommendations had been carried out—viz., to charge the scrubber with wood grids, and employ weak liquor or a small quantity of water in the vessels. The present purifiers were incapable of efficiently dealing with the daily volume of gas, and much lime was being wasted through having to be removed before it was saturated—a condition of things which would be much worse with the increased make of the next two months. Without any extension of plant, pure gas was impossible; and he suggested the oxygen process as an auxiliary to the present inadequate appliances. The limited storeage for liquid residuals necessitated their frequent removal, often at inconvenient times, and, viewed in respect of the disposal of products and the cartage of coal, it was a matter of congratulation that the opening of the new branch railway would effect a saving generally of 4d. per ton on all heavy materials both going in and out of the works, which would amount to a considerable sum at the end of the year.

MISCELLANEOUS NEWS.

THE FATAL EXPLOSION AT THE BRADFORD GAS-WORKS.

The Damage to the Works—Opening of the Inquest on Milner.

There is but little to add to the account given in the JOURNAL last week of the disastrous explosion which occurred at the Valley Road Gas-Works of the Bradford Corporation shortly after noon on the 3rd inst., and unhappily caused the death of one man and the serious injury of several others. Some particulars as to the situation and capacity of the wrecked works may, however, be of interest. As already stated, they are contiguous to the line of the Midland Railway—being close to Manningham Station; and, in point of producing power, they are really the largest of the four works owned by the Corporation, although those at Birkshall cover a greater area. The various buildings are located round a central yard, 300 feet long and 60 feet wide; the three retort-houses (each containing 200 retorts set in a double bench) being on one side, and the purifying-houses, meter-house, and blacksmiths' shop on the other. On this side, adjoining the washers, there were, before the accident, three sets of condensers and scrubbers; and beneath the yard are the tar-tanks, where the catastrophe no doubt originated, though how is at present unexplained. Simultaneously with the report of the explosion, large blocks of the pavement were thrown into the air, and fell crashing through the roofs of the adjacent buildings; and, a second later, two-thirds of the entire surface of the yard collapsed and fell into the tanks below. Two of the three sets of condensers were thrown over the wall of the washer-house, demolishing it, and injuring the roof of the meter-house and blacksmiths' shop. The Superintendent of the works (Mr. Akam) was in the meter-house at the moment of the explosion; and he described his experiences to a local reporter as follows: "I heard a rumbling noise, and part of the roof fell in. I ran out of the house; and, not knowing what had happened, I went to the end of No. 1 retort-house (the part of the yard which remained safe), and was just in time to see one of the condensers fall. Then a great jet of flame went up, from the gas in the broken condensers becoming ignited, and of steam; and I could see nothing. No. 3 condenser went down first; and it was part of it that came through the roof. I at once turned the exhausters off, and shut the valves in the purifying-house, to prevent the gas coming back from the holders and burning." All three retort-houses were in use at the time; and, as the connections with all of them had been destroyed, Mr. Akam had the lids taken off the retorts, so as to allow the charges to burn away. Attention was, of course, immediately directed to the injured men. The foreman Milner, who succumbed, had left Mr. Akam only just before the accident, and was on his way to the retort-house when he was struck on the head by a falling stone. Forrest, one of the injured men who were removed to the Infirmary, was engaged in tipping coke when the yard collapsed, and he was found lying on his back on the burning coke in the pit; Womack had an arm and a leg fractured, and was generally bruised; Wood sustained a fracture of a leg, and had a wound on his back; and Smith was slightly burned—not so badly, however, as to necessitate his detention in the Infirmary. At the time of the occurrence, the Chief Engineer (Mr. W. Wood) and his assistant (Mr. C. Wood) were at the Mill Street works. They were at once telegraphed for, and, of course, were quickly on the spot. The Town Clerk (Mr. W. T. M'Gowen) and the members of the Gas and Electricity Supply Committee, were also communicated with; and during the afternoon most of these gentlemen visited the scene. The Chairman of the Committee (Mr. Alderman F. Priestman) was away from Bradford; but he telegraphed his sympathy with the sufferers. The site of the explosion presented a curious spectacle to the engineers. At the entrance to No. 1 retort-house is the line of rails for running the coal-trucks from the main line into the stores. This was the limit of destruction of the vaulting of the tanks. One end of a rail was bent high into the air; and the gas-mains were in a similar condition. All the centre of the deep hole made by the subsidence of the vaulting was occupied by heaps of coke and pavement; while beyond, leaning on the wall of the meter-house, were the shattered pipes of the condensers. All the connections between the retorts and the purifiers having been destroyed, measures were at once taken to effect a junction with No. 1 house, so that a portion of the plant could be kept in use. The retorts in the other houses were drawn, and the fires gradually let down. Fortunately, the four gasholders are situated at some distance from the yard; and consequently they were uninjured. As they were fairly well filled, and as all the retorts at the other stations were brought into use, the explosion did not cause any immediate inconvenience. There is, however, little reserve producing power at the works; and as 400 of the 600 retorts at the Valley Road were rendered useless, an appeal had to be made to the consumers to be as economical as possible in the burning of gas while the necessary repairs are being carried out. These, of course, will take time, and will involve a large outlay. The work of clearing away the wreckage was well in hand on Monday last week; and during the day, Messrs. W. and C. Wood were busily occupied in devising arrangements to keep up the supply of gas. The erection of a temporary condenser was commenced on a piece of ground near the purifying-house; and, as soon as it was ready, a number of the retorts thrown out of use were to be again fired up. A meeting of the Committee was held in the Town Hall, under the presidency of Mr. Alderman F. Priestman; and a resolution of condolence with the friends of the deceased man Milner, and of sympathy with the sufferers, was passed. A general discussion then took place on the subject of the accident. The Engineer attended, and made a statement; but he was unable to point to the exact cause of the explosion. Eventually the meeting was adjourned till the next ternoon, when the Committee made an inspection of the works.

The Inquest on Milner.

The inquiry into the circumstances attending the death of the victim of the accident above recorded—Joseph Milner—was opened in the Town Hall on the 5th inst., before the Bradford Borough Coroner (Mr. J. G. Hutchinson). The Town Clerk and the Chairman of the Gas and Electricity Supply Committee attended; and the services of Mr. J. Waugh had been retained by the Coroner. In commencing the proceedings, the Coroner said the inquest was being opened earlier than usual after the event, in order that the work of reparation should be in no way delayed. He proposed only to receive formal evidence of identification, and to view the spot. The Town Clerk said the Corporation were, of course, extremely sorry that this accident should have happened, and that any of their servants should have received injuries. There would be a searching inquiry as to how the explosion had originated; but it appeared that it would be a matter of considerable difficulty. The one consoling thing was that there had been no neglect whatever in connection with the accident. Three officers of the works went over the very spot just after twelve o'clock on Saturday, and everything appeared perfectly right; yet the explosion happened just afterwards. It occurred happily during the workmen's rest; so that the injury to limb and loss of life were not what they might otherwise have been. Milner, the deceased man, was an old and worthy servant of the Corporation. He was a widower, and his two sons, the Town Clerk was glad to say, were in the Corporation service, and had been for some time. The injured men were going on satisfactorily. The Corporation and their servants wished to place themselves entirely at the command of the Coroner; and they would be happy to afford every information. The Corporation, he might repeat, regretted the occurrence exceedingly; but all the care and forethought in the world would not always guard against unexpected misfortunes. The jury then visited the scene of the disaster; being accompanied by the Coroner, the Town Clerk, Mr. Beaumont (Her Majesty's Inspector of Factories), Mr. J. Waugh, Mr. W. Wood, and other officials. They afterwards returned to the Town Hall, where formal evidence of the death was given by Dr. Whiteman, Junior House Surgeon at the Infirmary. He said that deceased, when admitted to that institution at about one o'clock on the previous Saturday, was unconscious, and never recovered. He was fearfully injured. He had several scalp wounds, some of his ribs were broken, and his jaw was fractured in several places. He died from shock to the system, at about half past five in the evening. Abraham Milner, gas-stoker, formally identified deceased as his father. Witness said he was close to the explosion when it happened, and he was lifted on to some coals. He and the other men present ran from the spot as best they could; and then, when it was found that some persons were missing, they searched the *débris*, finding the deceased. The inquest was then adjourned until the 14th inst.

IMPROVEMENTS AT THE DUNDEE GAS-WORKS.

As intimated by our Scotch Correspondent in his "Notes" last week, some extensive alterations and improvements have recently been made at the Dundee Corporation Gas-Works. Previous to June of the present year, the exhausting machinery consisted of four exhausters—two of Beale's newest design, each capable of dealing with 80,000 cubic feet of gas per hour; and two of Laidlaw's old pattern, each equal to passing 50,000 cubic feet of gas per hour. The two latter have been removed, and two of Beale's patent, manufactured by Messrs. Bryan Donkin and Co., each of 100,000 cubic feet per hour capacity, have been substituted. These two exhausters, and the horizontal engine which works them, have been placed on the same bedplate; and they form a compact and substantial job. They have been doing constant work for the past eight weeks, and have given the utmost satisfaction. They work almost noiselessly, and maintain a perfectly steady gauge. The contract was entrusted to Messrs. J. and H. White and Cooper, of Dundee, who placed the exhausters and attached them to the engine. For many years the Dundee Gas Commissioners treated the residuals in their own works; but when a tempting offer was made by outside firms to purchase the products in their raw state, they resolved (the distilling plant in the works being in a half worn-out state) to accept the offer. The contract having now come to an end, the Commissioners decided to return to their original policy, and instructed the fitting up of plant for the manufacture of naphtha and sulphate of ammonia on the works. The plant formerly employed for producing the latter was considered the best of its kind when it was erected. Recent improvements, however, made it necessary to give attention to the apparatus of other makers; and, after inquiry by the Gas Engineer to the Commissioners (Mr. J. M'Crae), it was resolved to adopt Messrs. C. and W. Walker's patent process. The plant which has been fitted up includes a large still, divided into trays, over which the liquor passes, where it meets steam going upwards; and the result is that, after being treated with lime, almost every trace of ammonia is driven off—the waste liquor containing only about 0·01 per cent. of ammonia. The process is a continuous one; and it is found that there is less injury to the plant by expansion and contraction than is often experienced. The resulting sulphate is of a good grey, almost white, colour; and by the plant introduced, six tons per day can be manufactured. The tar-stills were in a very worn-out condition; and, as in this department it is essential that everything should be of the very best description, it was resolved to renovate it. Two new stills, worms, separators, &c., have accordingly been procured and fitted up. The stills are somewhat unique in one respect—viz., that they are not built in by brickwork, nor are they under a roof. They are placed on simple foundations, quite clear all round; their only protection being a heavy coating of non-conducting material, which not only protects the steel plates from the action of the weather, but also gives a decided saving in fuel. The stills are worked by steam, and the boiled tar is disposed of. They are capable of distilling upwards of 7000 gallons of tar per day. In the event of the price derived for tar not being remunerative, the steam-boilers can be fired up by it, as, indeed, they are at the present time, by means of a patent injector, which is found to work well. Of course, it is a matter of calculation when this should be done and when it should not, because it might be the case that coal or coke firing would be more economical than using tar. The whole of the improvements have been carried out by Mr. J. M'Crae; the plans having been prepared by his son and assistant, Mr. W. M'Crae.

THE GAS CONSUMERS' CONGRESS AT LYONS.

We learn from the current number of the *Journal de l'Eclairage au Gaz* that the "Congress of Representative Gas Consumers" from various towns in France, to which reference was made in the JOURNAL last week, was held at Lyons on the 27th ult., as arranged. About 60 delegates assembled; and one of the rooms at the Hôtel de Ville was placed at their disposal. There were two sittings—one in the morning, presided over by M. Vignet; and the other in the afternoon, under the presidency of M. Pallière. In addition, there was a public gathering in the evening at the Théâtre Bellecour. M. Vignet opened the congress by thanking the delegates for attending, and expressing the hope that their proceedings would result in ensuring for the gas consumers a victory over the holders of monopolies. They had, he said, undertaken a work of social justice; and, in addition to the support their efforts had received from the Lyons press, they had on their side public opinion generally. He then called upon M. Pallière, the Secretary of the Organizing Committee, who read a list of the towns represented—Paris being among them. He explained that the object of the congress was to find out if the monopolists were always to be masters—if the holders of concessions could not be made to bow before those who had granted them their privileges. They hoped to arrive at a practical solution, and overthrow monopoly. He urged those present to discuss their interests, and in that discussion Parliament would, he said, be able to find weapons which it could use when the right time came. It might be necessary to have another meeting, if the present monopoly continued. But let them carry on the struggle with courage and with unity, and in the end they would be victors. These remarks were very cordially received. Some conversation thereupon ensued as to the general direction of the "strike" movement; and it was decided to leave it entirely in the hands of the Lyonnese, with whom it had originated—MM. Charpentier and Lopies being appointed Secretaries. The delegates then formed themselves into three committees, under the presidency of MM. Clermont, Demenge-Grémil, and Vidau. This closed the morning's business.

In the afternoon, M. Pallière opened the proceedings by reading a proposition submitted by the delegates from Le Puy, asking for the withdrawal of the circulars of 1884 and 1889 of the Minister of Public Works, on the subject of the occupancy of the national roads by mains; and it was referred to Committee No. 2. Reports were then submitted on the work of the three Committees during their sittings in the morning. Committee No. 1 had before them the question of the importance of lighting and heating, regarded from a social and economical standpoint; and, in connection therewith, the rights and responsibilities of gas consumers. They came to the following conclusions: That, with certain exceptions, the principle of free competition should be rigorously applied in the matter of lighting; that, in the event of the violation of the terms of a concession, the powers conferred by an executive authority should be withdrawn, subject to the parties interested being indemnified to an amount to be proportionate to the intrinsic value of their working plant; that concessions of a lighting monopoly ought not to be granted by communal authorities until they have been submitted to the formality of an inquiry *de commodo et incommodo*, as prescribed by law; that the Boards of the concessionary companies should have upon them representatives of the communes and the consumers; and that, after the payment of the working and management expenses, and making provision for the interest and sinking fund, all profits should be divided among the consumers, in the shape of reductions in price. Another question which came before the Committee related to the price of gas, and the best means of effecting a diminution therein. To this the Committee replied to the following effect: In order to obtain any concession in price, it will be necessary to apply, not only to the gas companies, but to the municipalities upon whom they depend. In the event of both determining to keep up the present charges, notwithstanding the arguments brought before them by delegates appointed for the purpose, steps will have to be taken, in each place, to form a league whose mission it will be, either through the newspapers or by means of public meetings, to proclaim the cause of the gas consumers, by showing that upon them alone presses an impost which should be borne by the entire population. Should the companies and the municipalities still refuse to yield, then the gas consumers are to pledge themselves to abandon gas and resort to mineral oil; and, in order to attack the municipalities, shopkeepers who employ gas are to close their establishments at nightfall. Passing now to the work of Committee No. 2, the questions dealt with by them related to the undertaking of public and private lighting by communal authorities, the canalization of the national roads, the competition of electricity and mineral oils with gas, and the strict observance of the terms and conditions of concessions. Their recommendations were as follows: To demand a reduction in price to 15c. per cubic metre (3s. 4d. per 1000 cubic feet) at the outside; to call upon municipalities to compel the companies to grant it, and, in the event of refusal, to make those who have not strictly carried out their concessions forfeit them; to petition the Minister of Public Works to allow prefects to have the granting of authority to use the national roads; to favour electric lighting companies, by way of competition, but without granting them any monopoly; to request municipalities to remove the *octroi* duties on petroleum, and to petition the Legislature to remit or reduce the taxes on this illuminant, or at any rate to make them equal for both crude and refined qualities; and to ask municipalities not to enter into fresh treaties with companies, and not to renew those existing. Several questions relating to monopolies were submitted. The congress demanded, first of all, their entire suppression, and the abolition of all concessions. They invited municipalities, if they granted a concession for a gas undertaking, to stipulate that the consumers should participate in the profit by having gas at a reduced rate. It was intended to draw up a special form for use in such cases, to be subject to revision when circumstances called for it, but at least every five years. It was recommended that the application of the new tariffs on mineral oils should take place from the 1st of January next; and that the municipalities, especially those of Paris and Marseilles, should be invited to take the necessary steps to obtain a remission of the duties upon petroleum. In view of the disastrous consequences to industry of the creation of monopolies of raw materials, and seeing that petroleum was seriously threatened, the Government should be called upon to put into force, without hesitation, the law now in existence relative to the coalition of monopolists. Municipalities, while respecting the treaties which bind them in regard to the public lighting, should facilitate competition in the supply of gas to private consumers, especially by granting powers over the urban roads. The work of Committee No. 3 does not appear to have been so heavy as that of the other two. They came to the conclusion that the existing monopolies should be suppressed at the expiration of their concessions; that no gas or electric light undertaking should be sanctioned without the conditions having been first investigated; and that the lighting tariffs applied to communes and consumers should be readjusted.

An incident occurred in connection with the proceedings of Committee No. 2 which is worthy of mention. M. Long brought forward, for the opinion of the full congress, a motion which had been rejected by the Committee. It was to the effect that those towns where the concessions stipulate that the gas company shall adopt for public and private lighting the system in vogue in Paris, shall be requested to enforce this stipulation, or compel the company to relinquish the monopoly granted to them, and at the same time specify that the price of electricity is not to be higher than that of gas, reduced in accordance with the views of the congress. This proposition, which was supported by several of the Lyons delegates, was strongly opposed by those from Marseilles; and a warm discussion ensued. In the end, the President declared it carried by 26 votes to 22. The Marseilles representatives raised a violent protest against the result of the voting. Everybody began to speak; and there was a general disturbance. M. Vignet came forward as a peacemaker; and, thanks to his interference, order was gradually restored. M. Cressard, of Marseilles, brought this lively incident to a close by proposing a motion which rallied all the delegates. It was as follows: "The congress resolves that those towns which are desirous that their gas companies should also supply electricity should require it to be furnished at the price fixed by the congress for gas." This motion was adopted with one dissentient—M. Gassier, a Marseilles delegate, who immediately withdrew from the meeting in indignation at the attitude of the representatives. Thereupon the other Marseilles delegates protested against M. Gassier's conduct, and declared that there was no "solidarity" whatever between them and him.

At the evening meeting, M. Pallière, who presided, thanked the delegates who had come to Lyons to join the representatives of the consumers there in carrying on the struggle in which they were engaged with powerful companies. He gave the history of the gas "strike" movement in Lyons, and expressed his gratification at the results achieved during the five months the agitation had been going on. He also thanked the Municipal Council of Lyons for the moral and material support they had given to the organizers of the congress. In conclusion, he announced the creation of a federation of gas consumers, and named Nancy as the place for holding the next meeting. Dr. Augagneur followed. He assured those present that the end he and his colleagues had in view was in no way political. What they and gas consumers generally wanted was light at a low price—light paid for according to its value. In France the price of gas was from 28c. to 35c. per cubic metre (6s. 3d. to 7s. 10d. per 1000 cubic feet), whereas in Belgium it was 18c., and in England 10c. per cubic metre (4s. and 2s. 3d. per 1000 cubic feet). The object of the present movement was to bring down prices to a figure more acceptable to the consumers. To do this there was no need to resort to revolutionary methods; legal ones being quite sufficient. It must not be forgotten that in a few years the greater number of the concessions granted to gas companies would expire; and the duty of the consumers would be to take care that they were not prolonged, for to consent to an extension would be to sacrifice the future. M. Charpentier then read the resolutions adopted at the congress; and M. Pallière closed the proceedings with a few hopeful words in regard to the future of the organization.

SULPHATE OF AMMONIA AS A FERTILIZER.

[From the *Chemical Trade Journal*, Dec. 3, 1892.]

The question of the real fertilizing value of sulphate of ammonia has recently been made the subject of special investigation by the German Agricultural Society. In making his report, Dr. Wagner says the two points which he was directed to investigate were the following: Is ammonium sulphate a thoroughly reliable fertilizer—a fertilizer in which the farmer can place complete confidence? and then the further question: In what relation of value does ammonium sulphate stand to sodium nitrate, the so-called Chili saltpetre, which at present rules the market? He has paid considerable attention to the effect of nitrogenous manures upon cultivated plants; and, during the last four years, he has made, along with his assistants, several thousand experiments upon the manuring of plants, with nitrates and ammonium compounds. The results of these have recently been published in a detailed work; but for the present we shall confine ourselves to the following questions only: Can the action of the ammonium salt be relied upon in all cases? Can the farmer apply it in all kinds of soils and to all kinds of plants with the same certainty of result as Chili saltpetre? These questions have hitherto been answered with a decided "No."

The Prevailing Objections to its Use.

It is to Marcker that we owe numerous field experiments upon the relative actions of ammonium salts and nitrate; and these experiments have shown how irregular the action of the ammonia is. At one time it would show an action that was not less than that of a corresponding amount of nitrate; while at another it would be so small that, especially in the case of certain crops—such, for example, as beets and potatoes—it was believed that the application of ammonium sulphate must be quite given up. The causes of these great irregularities in the action of the ammonium salt were, however, not known. It was suggested as possible—and some experiments seem to confirm this view

—that the ammonia nitrogen could, under certain circumstances, have a deleterious effect, or that the sulphuric acid combined with the ammonia might, under some conditions, be injurious.

It was believed that certain plants showed particular sensitiveness towards ammonium salts; and it was also held possible that in some soils the necessary change of the nitrogen of the ammonia into the form of nitric acid proceeded too slowly. In short, all kinds of theories were proposed to account for these remarkable variations in the action of the ammonium salt.

It will be readily conceived that, under these circumstances, farmers showed but little inclination to employ sulphate of ammonia. Nitrate acted more certainly, could be used for all plants, and could not only be applied at sowing-time, but also as a top dressing in April, May, or June, according to desire; moreover, the price of nitrogen as nitrate was not higher than that in the form of ammonia. In addition to these influences, we must remember that many accounts of failures with ammonium sulphate, and sometimes on a very large scale, were published from time to time.

Dr. Waddington's researches, carried on for a number of years, had shown, for example, that the action of nitrogen as ammonia only amounted with peas to 69 per cent., with potatoes, to 47 per cent., and with hay grass, to only 31 per cent. of that of nitrate. Dr. Bassler had, moreover, obtained an increased yield of only 37 kilos of potatoes by the use of ammonium sulphate; while, with a corresponding amount of nitrate, the increase amounted to 1500 kilos. Dr. Samek published the results of certain experiments with forage beets in which the action of the ammonia nitrogen was shown to be only 16 per cent. of that of the nitrate.

It is clear that, under such conditions, sulphate of ammonia must come more and more into discredit; and Dr. Wagner himself was the first to draw the attention of the farmer to the great uncertainty of the action of sulphate of ammonia, and to the small extent of our knowledge in all matters relating to the action of ammonia. He felt that he owed this to the farmers. Although this behaviour on his part gained for him some reproaches both in Germany and other countries, yet, under the same circumstances, he says he should again act in precisely the same manner. It is the distinct duty of all investigators to expose all gaps in our knowledge, just as much as it is his duties to fill up those gaps. If Dr. Wagner has been to some pains to perform the first portion of these duties, he has been at no less trouble to carry out the second to the best of his ability.

The Objections Answered.

If, some years ago, it was said that the ammonium salt was not certain in action, to-day, in the light of investigations carried on in the intervening period, it can be shown that ammonium sulphate can be employed for fertilizing purposes with the same degree of certainty as Chili saltpetre, by explaining the causes to which the unfavourable action of ammonia-fertilizing has been due, and by stating the conditions under which the effect of the nitrogen of ammonia reaches its highest point, and acts with no less certainty than the nitrogen of Chili saltpetre.

The main conclusions drawn by Dr. Wagner from the whole of his work are summed up in the following paragraphs:—

(1) He has never been able to obtain a deleterious action of the ammonia, even with exceptionally high amounts.

(2) The sulphuric acid of the ammonium sulphate has no evil effect on the vegetation in the quantities usually employed for fertilizing.

(3) Ill-effects due to the use of solutions which are too concentrated are produced more easily with solutions of nitrates than with those of ammonium salts.

(4) The effect of ammoniacal nitrogen is considerably less than that of nitrate if the soil is deficient in carbonate of lime. On unlimed land, the action of the ammonia only amounted to 28 per cent. of that of nitrate; while on limed land, the other conditions being the same, the action was 90 per cent. of that of nitrate.

(5) A similar state of things occurs when the soil is lacking in potash salts. The soda of the Chili saltpetre is able in such cases to replace the lacking potash to some extent. An addition of common salt, or potash salt, containing soda, increases the effect of the ammonium compounds in such circumstances.

(6) When all the necessary conditions for the proper action of the ammonium salts are fulfilled, the action of these amounts, in round numbers, to about 90 per cent. of that of a corresponding quantity of the nitrate.

7) The action of the ammoniacal nitrogen exceeds that of nitrate when continued rains and a very porous soil have allowed the nitrate to penetrate too far into the soil.

(8) The action of the ammoniacal nitrogen also exceeds that of the nitrate when the soil has been rendered, by the repeated additions of kainit, so rich in soda that a further addition of the latter, which is contained in the nitrate, is injurious.

9) The fertilizing value of the ammoniacal nitrogen may be said to be on the average, in practice, equal to that of the nitrate, provided the ammonium salt is applied in a rational manner —all the conditions of the case being properly considered.

These results justify the statement that ammonium sulphate now belongs to those fertilizers which, when properly employed, can be relied upon to produce a proper effect, and in which the farmer can thoroughly trust. We are now in the position to say definitely to the farmer under what conditions the sulphate will have the maximum of action, what precautions must be adopted to ensure its efficacy, and under what circumstances Chili saltpetre should be preferred to ammonia, and *vice versâ*. We have thus gained much; and what remains to be done is not difficult. We have now, to make these experiments useful in practice, to make them known as widely as possible, to remove the present erroneous ideas, to confirm the trustworthiness of the ammonium salt, and in every way to spread clear and accurate information upon this question.

THE ELECTRIC LIGHTING OF THE CITY STREETS.

A Remonstrance from The Gaslight and Coke Company.

At the Meeting of the Commissioners of Sewers of the City of London last Tuesday, the Clerk (Mr. H. Blake) read a letter from the City of London Electric Lighting Company respecting the public lighting in the main streets, and recommending that the Engineer should be instructed to give notices for proceeding with the work of the remaining streets. The Engineer (Mr. W. Haywood, M.Inst.C.E.) said he thought he ought to read to the Court an important letter he had received from The Gaslight and Coke Company. There was a clause in the contract with the Electric Lighting Company by which they might use the gas-lamps which remain in the main thoroughfares lighted by electricity. He had recently written to the Gas Company, asking their permission to put an appliance into the lanterns so as to permit of the use of an incandescent electric light. In reply to that letter, he had received an answer detailing the objections the Company raised to this proposal. The Company complained that they found some unauthorized persons had at times lighted the lamps in certain streets, owing to the partial failure of the electric light; and boys were in the habit of turning on the cocks from the tops of omnibuses which stopped close to the lamps. These and other causes had led to an escape of gas; and it was hardly to be expected that they would recognize the use of gas in this way in assisting an opposition means of street lighting. The Engineer said the letter simply meant that the Commissioners had not the power in the future, in the event of a failure of the electric light, to turn on the gas. Mr. Barham moved that the letter should be referred to the Streets Committee. Mr. C. D. Miller said it seemed to him that London was very much behind cities on the Continent in the matter of electric lighting; and, if it was carried out here as it was abroad, there would be no need for gas. Mr. C. T. Harris declared that, unknown to the majority of the Court, the lights had been increased from 395 to 515; and the cost of lighting would be £3000 a year more than was expected. He moved, as an amendment, that the whole matter be referred back to the Committee for consideration. The Engineer explained that, viewing the contract and the plan together, he was well within the number of lamps originally agreed upon; but he reminded the Court that there was no city in Europe that was lighted simply and solely by the electric light. Mr. Miller observed that, in London, gas would do very well in the side streets. Mr. Hollington said, whenever this subject came up, Mr. Harris was a stern opponent to the lighting of streets by electricity, and, without exception, he strenuously opposed all progress in this direction. He therefore warned the Court against the sophistries of Mr. Harris in the interests of the Gas Companies. Mr. Harris protested against this observation; saying that he had never done so in the interests of the Gas Companies, but of the ratepayers. Mr. Hollington having withdrawn his assertion, the amendment was, after some further discussion, voted upon, and rejected by 22 votes to 11. A report of the Streets Committee, recommending that the Engineer be directed to give the requisite orders to the City of London Electric Lighting Company for placing incandescent lamps in the bye-streets, in order to complete the electric lighting of the City, was referred back for further details as to the extra cost alleged to be incurred in this mode of illuminating the smaller thoroughfares.

ROCHDALE CORPORATION GAS SUPPLY.

The Proposed Gas-Works Extensions.

On account of "some uneasiness in the town, either real or assumed," with regard to the projected extension of the Rochdale Gas-Works, Alderman Petrie made a statement on the subject at the last meeting of the Town Council. He remarked that it was said the suggested expenditure of £65,000 was unnecessary and extravagant; and their critics had even gone so far as to say that the object of the proposal was to block the way of the electric light. The author of this statement must think the Committee very lacking in ingenuity, not to say in common honesty, if he thought they could find no less cumbrous way of "blocking" the electric light than by proposing to spend £65,000 for something that was unnecessary. It had been shown already—he had proved it to the satisfaction of the Council, at any rate—that the present works are used to the full extent of their capacity. They could produce no more gas there in the winter than they had done. That was fact number one; and fact number two was that the consumption of gas in the town was increasing, not by fits and starts, but steadily month after month and year after year. Put the two facts together; and it became clear that they must extend the works. It might be said, "If you introduce the electric light, you would check that increase in the consumption of gas." People who said this had not studied the history of the introduction of electric lighting. Whether it be that the more brilliant light of electricity stimulated the burning of gas to compete with it, or whether it was that gas was now used for so many purposes besides illumination, true it was that wherever the electric light was introduced, the consumption of gas went on increasing quite as fast, and very often more rapidly, than before. It might be taken as a fact that, if electric lighting was introduced, the consumption of gas would not be decreased. Some persons might say that what they needed might be done for a less sum than £65,000. His answer was that, for the work to be carried out, this was a very reasonable sum. Nearly half the amount would be spent in providing a large new gasholder. For a long time they had been working somewhat uneconomically, by not having sufficient storeage capacity for the gas they were making. If a breakdown happened, and stopped the works for only a few hours in the winter, the town would be without gas, for there was only holder capacity for a few hours' supply. The remainder of the sum was required for the extension of the plant and the improvement of the approaches to the works, by which they hoped to lessen the annual cost of bringing the coal from the railway. As to the electric light, he wished it to be distinctly understood that the Gas Committee were not its enemies.

It was a good and a beautiful thing; but as yet it was an expensive luxury. If they introduced the light into the town, it would be certain for a few years at any rate, to be a monetary loss to them. When the Committee felt that the time was ripe for its introduction, he hoped every member of it would be as diligent, and even enthusiastic, in the task as they had been in any other. Considering the amount of money with which the Committee had been entrusted in the past, he thought they might be given credit for a resolve to spend this wisely. The Mayor (Mr. Duckworth) asked Alderman Petrie to say whether the proposed alterations would greatly add to the permanent working expenses of the place. Alderman Petrie replied that the Committee hoped the effect would be in the opposite direction. By adopting all the latest improvements they were cognizant of, they hoped to be able to work at even less expense than at present. The short discussion which followed chiefly turned on the question of electric lighting—one member suggesting that water power should be utilized for generating electricity, and another thought it was time that the Gas Committee took the matter into consideration, and tried at all events a small installation.

AN ELECTRIC LIGHTING INSTALLATION FOR NOTTINGHAM.

In November last year, the Electric Lighting Committee of the Nottingham Corporation submitted a report on the lighting of the borough by electricity; and they have delayed making a further statement on the subject until now in order that they might carefully consider the best steps to be taken, and obtain information to guide them. In this fresh report, it is mentioned that Mr. H. Talbot, an electrical engineer, was appointed to make himself acquainted with the requirements of the central portion of the town; and he recommends the low-pressure continuous current three-wire system, in combination with the high-pressure continuous current and transformers. The purchase of a site of land for the central station is proposed at a cost of £10,175; and the capital outlay on buildings, plant, mains, &c., is computed at £34,580—making a total of £44,755. Accompanying the report is one by Mr. Talbot, which shows that he strongly advises that the buildings at the generating station should be at first designed to contain sufficient plant for supplying electrical energy for 13,000 8-candle power lamps, but plant should only be put down for 10,000 lamps. He places the approximate cost of working such a station, including maintenance and depreciation, and assuming that the whole of the lamps will be in use for 600 hours per annum, at £3509; and the revenue derived from 10,000 lamps, assuming that each lamp is in use for 600 hours per annum, and 6d. per Board of Trade unit is charged, at £4950—showing a profit of £1441, or 4 per cent. on the cost of the installation, exclusive of the land. The revenue from the same number of lamps, if in use for 700 hours each per annum, will be £5775; and the approximate cost of working the station for supplying 10,000 lamps for 700 hours per annum will be £3587—giving a profit of £2188, or 5¾ per cent. interest on the cost of the installation, and a proportionate part of the capital (viz., £3500) expended on the site. He states that it is found in practice that only three-fifths of the lamps installed are ever in use at one time; so that it is perfectly safe to connect 17,000 lamps to the mains of a central station having machinery capable of supplying 10,000 lamps. If 16,000 lamps are so connected, and are used for 600 hours per annum, the revenue from them will be £7920, and the cost of producing the electrical energy, including maintenance and depreciation, will be approximately £3789, showing a profit of £4131, or more than 10 per cent. interest on the cost of the installation, including a proportionate amount for land. These reports were mentioned at the meeting of the Town Council yesterday week, when the Mayor announced that a special meeting would be called to discuss them.

LEEDS CORPORATION GAS SUPPLY.

Gas-Meter Rents.

At the Meeting of the Leeds County Council last Wednesday, Mr. Carter brought forward a resolution in favour of the abolition of gas-meter rents within the borough from July 1 next, and the provision by the Gas Committee for any loss thereby sustained. He thought the time had now arrived when this matter might be dealt with, as he found that, in Birmingham, Blackburn, Blackpool, and some other towns, no meter-rents were paid. Alluding to the way in which the Council had previously thrown out this proposal, he said the working classes were in support of his motion. The small consumers had to pay 2s. a year; and he had been told by working people who did not burn gas that they would do so if it was not for the meter-rent. If they abolished the charge, he felt persuaded that more gas would be consumed. He believed that the meter-rents yielded £10,800, and 1d. per 1000 cubic feet added to the price of gas would bring in £8800—leaving a difference of something like £2000; but he thought the Gas Committee might see their way to make that up. Mr. Hirst seconded the motion. Alderman Scarr remarked that, if the members wanted to increase the price of gas 2d. per 1000 cubic feet to the consumer, they should vote for Mr. Carter's resolution. If that gentleman had studied the question, he would have known that no person in the town who paid £1 per year for gas really paid for what he consumed; the expenses in connection with the administration, and one thing and another, being so great. It was no injustice to the poor consumer. They sold the gas at less than cost price, because the residual products had dropped in value; and they were keeping down the price of gas in the hope that the residuals might produce more during the next half year, and thus wipe off the balance. Alderman Gilston said this was perhaps the most inopportune of times to deal with the question, if even there was anything in the principle. To begin to meddle with the finances of the Gas Committee, when they were over head and ears in debt, was hardly the best time to do it. It had been said that they were working at a loss; but he believed they were now working at a profit. The practice of the Gas Committee had been to deal justly with all consumers of gas, and to let every consumer, large or small, have gas at the cost at which it was produced, without taking a single farthing of profit; and everyone, for the last three half years, had been consuming gas at less than it cost to produce it. Now, the Committee were asked to give up £10,000 a year from the meter-rents; and this would have to be met in some way. They would have to put 2d. per 1000 cubic feet on to the price of gas; and it would mean a gross injustice to many of the consumers. It would represent an increase of £115 a year to one firm, and an increase of £275 to another. He hoped the Council would see the wisdom of continuing the practice of making every person in the town pay for what he obtained, and no more. The cheapness of the gas supply, he had no hesitation in saying, had been the means of promoting certain industries in the town. Mr. Harland thought the Council would act wisely in adopting the motion. Mr. Pickersgill contended that it was simply taking the money out of one pocket and putting it into another. It would be a question of from £750 to £1000 in the Lamp Committee's bill for the public lamps; and they would have to curtail the public lighting. Mr. Gordon argued that to continue to charge meter-rents was to discourage the burning of gas, and so to diminish light in the town, and in every sense to do damage to the poor man by not giving him the chance he might have. He contended that, if the gas business was properly managed, it ought to be a great co-operative success. Mr. Battle said he was to some extent in sympathy with the proposal, but thought it went too far. He moved, as an amendment, that the gas-meter rents in all inhabited houses at a less rental than 5s. per week within the borough be abolished from July 1 next, and that the Gas Committee make provision for the loss thus sustained. The amendment was not seconded; and, after a prolonged discussion, the resolution was rejected by 24 votes against 22.

WARRINGTON CORPORATION GAS SUPPLY.

Proposed Extension of the Works.

Last Wednesday, Colonel Hasted, one of the Inspectors of the Local Government Board, held an inquiry at Warrington into an application by the Gas Committee of the Warrington Town Council to borrow £20,000 for the purpose of extending the gas-works at Longford. The Town Clerk (Mr. J. L. Whittle) submitted a statement showing the progress of the works since they were acquired by the Corporation in 1877 at 25 years' purchase, at a cost of £153,000. The Corporation had carried on the works with £26,200 less capital than the old Company. The borrowing powers were unfortunately limited to £20,000. The price of gas in 1877 was 4s. per 1000 cubic feet in the borough, with an additional 6d. per mile radius outside the borough, and with a discount of 6d. to 1s., according to the amount consumed. The Corporation had reduced the price to 3s. 6d. per 1000 feet, with the same allowance for discount. The cost of the reduction was about £30,000, of which the consumers had had the benefit. This was not the only benefit to the ratepayers; for the cost of street lighting had been reduced from £2 14s. to £2 per lamp. This represented a saving of £700 per annum to the ratepayers' pockets. In addition, through the Gas Committee, £2000 had been paid out of surplus profits to the borough fund; and a reserve fund, which now stood at £3742, had been established. During the fifteen years since the acquisition of the works, from time to time £12,000 had been spent out of profits and capital expenditure. In 1851 the population was 22,894; and it was now estimated at 53,000. The rateable value in 1851 was £52,499; and it was now £169,440. The net debt of the Corporation was now £543,227; but apart from the trading concerns—the gas-works and water-works—it was only £108,000. The consumption of gas in 1847 was 16 million cubic feet; in 1857, 35 million feet; in 1867, 67 million feet; in 1877, 120 million feet; and in 1892, 226 million feet. It was estimated that the output doubled itself every ten years. During this year the town had been within two or three hours of darkness. Mr. W. S. Haddock, the Gas Engineer, said the present storeage accommodation was a million cubic feet; and the maximum output for one day had been 1,140,000 cubic feet. The Committee had accepted tenders for additional plant amounting to £14,415; and the work was partly in hand. Mr. Haddock also explained to the Inspector the plans of the proposed extension. In the course of further evidence, Mr. Dixon, a member of the Council, complained that the price charged for gas was very excessive.

NEWTON-IN-MACKERFIELD GAS SUPPLY.

Local Government Board Inquiry.

On Friday, the 25th ult., Major-Gen. H. Darley Crozier, R.E., and Mr. E. P. Burd, representing the Local Government Board, held an inquiry at Newton with respect to an application by the Improvement Commissioners for powers to borrow £10,000 for gas-works purposes, and to vary Local Acts and Provisional Orders in reference, among other things, to the application of the profits from the gas and water works. The Law Clerk (Mr. Worsley) pointed out that, under section 50 and 51 of the Newton District Improvement Act, 1855, the Commissioners had not only to provide 1-30th part of the principal due on account of the gas and water works, so as to repay the loan in 30 years, but also to put the surplus revenue to a sinking fund, out of which the cost of extensions, &c., was paid. By this arrangement, the whole liability in respect of the works would be defrayed by the present generation of ratepayers. The Commissioners thought the profit, after setting aside the amount required for interest and the payment of the proportion of the principal, should be applied to the reduction of the general improvement rate. The Surveyor (Mr. R. Brierley) stated that the profit on the gas-works was about £1000 a year. The water was purchased at cost price from the London and North-Western-Railway Company. The Commissioners charged a rental for the water supplied, and also levied a rate of 1d. in the pound. The present price of gas was 2s. 3d. and 2s. 2d. per 1000 cubic feet. The Inspectors took evidence under five heads of the proposed Order, and the inquiry closed.

THE BRITISH WATER-GAS INDUSTRY.

Proposed Amalgamation of the Companies.

To-day the annual meetings of the British and North British Water-Gas Syndicates are to be held—the former in Leeds, the latter in Glasgow; and, in view of this fact, we give below the principal portions of the reports to be presented to the proprietors.

In their report to Sept. 30 last, the Directors of the British Water-Gas Syndicate, Limited, express regret that they are unable to announce the progress they anticipated last year, and for which, they say, they have been "earnestly striving in the face of innumerable difficulties." Progress, however, has been made; and the Directors have "no reason to be dissatisfied with the future outlook for the applications of water gas." The Auditors' report states as follows: "The value of the patents, we note, is taken in the balance-sheet at the same amount as last year, and no portion has been written off, nor has any depreciation been written off the Uddingston works or the office furniture at Leeds. The Uddingston works have, however, been maintained in an efficient state. The various stocks have been taken and vouched for by the respective Managers. Of the shares held by this Syndicate in the North British Water-Gas Syndicate, Limited, and the Yorkshire and Lancashire Water-Gas Company, Limited, we find that the vendors' shares have been taken at par, and the purchased shares at the actual cost; but we beg to draw attention to the fact that, at the date of the accounts, there were no quotations for any of these shares. We beg again to remind you that, by an agreement dated Aug. 22, 1889, 19,800 of the shares held in the North British Water-Gas Syndicate, Limited, are not entitled to rank for dividend until 50 per cent. has been paid on the remaining 40,000 shares of the North British Water-Gas Syndicate, Limited. In the last balance-sheet there appeared as an asset the sum of £101,000—being the amount of purchase-money to be paid by the Nottingham and Derby Water-Gas Company, Limited, as follows: In shares, £51,000; in cash, £50,000—as to which an action had been brought by the British Water-Gas Syndicate, Limited, for specific performance of contract. This action has been compromised, under an agreement dated May 4, 1892, by payment to the parent Syndicate of £15,000 in cash; the whole of the patent rights and licences of the Nottingham and Derby Water-Gas Company, Limited, being restored to the parent Syndicate. Out of the £15,000 received, a sum of £5000 was paid to the promoter to compromise his claim for £23,758 17s. 6d. previously credited to him for the promotion of the Nottingham and Derby Water-Gas Company, Limited; the promoter being entitled in addition, under an agreement dated May 20, 1892, to one-fourth of any profit from granting royalties or licences for user in the district covered by the licences granted to the Nottingham and Derby Water-Gas Company, Limited. The profit appearing in the balance-sheet is £190,076 12s. 5d. This is, of course, subject to the realization of the assets, and is not profit actually made. The trading account of the Syndicate shows a loss of £7095 1s. 4d. It is explained that the main cause of this was unexpected difficulties, which have necessitated an expenditure at various installations in excess of the contract prices."

The Directors of the North British Water-Gas Syndicate, Limited, open their report in much the same terms as those employed by the Leeds Board; and they express their regret that the results of the Company's business still continue to be unsatisfactory. The testing of the water-gas plant for steel making at the Newburn Steel Works has been delayed from many causes; but the Directors are now convinced that the 30-ton furnace erected there is, on account of its great size and extreme length, unsuitable for the application of water gas. This furnace was, they say, erected by the British Water-Gas Syndicate, Limited, after careful consideration by men of experience in the use of water gas, upon the lines of the 15-ton furnaces at the Leeds Forge, which have worked successfully; but the results have shown that the full advantage of the high heating value of water gas cannot be obtained in so exceptional a furnace as the one erected at Newburn. But it is hoped that, when altered as shown by experience to be necessary, the anticipated results will be obtained. The puddling-furnace erected at the Glasgow Iron and Steel Company's works has been completed; and, notwithstanding very serious obstacles, it has been successfully worked, although, on account of the conditions under which the work is done, the full advantage of water gas has not yet been attained. The Directors are in course of negotiating a contract for the supply of a water-gas plant and furnace for welding tubes in one of the principal tube-works in the neighbourhood of Glasgow; and they have grounds for hoping that the process will be successfully applied and largely adopted in this important branch of industry. They are informed that, in other districts of the country, water gas has been successfully utilized for various purposes; among others, for welding wheels at the Lancaster Waggon Company's works, Lancaster, and for singeing cloth at two factories in Yorkshire. In these circumstances, they hope that the application of water gas to various branches of manufacture will yet become an assured success. As in previous years, the Company's expenses have been kept as low as possible; and the Directors have, in the meantime, not drawn the fees to which they were entitled. The profit and loss account, which accompanies the report, shows a balance of loss, for the year ending Oct. 31 last, of £640. We learn from a circular which has been issued that, at the close of the ordinary general meeting, an informal meeting of the shareholders will be held, when the Directors will make a statement as to a proposed scheme of amalgamation of the three existing water-gas companies, which the Boards of the respective companies have agreed to recommend to their shareholders. It is stated that this scheme, if ratified, "while obviating the necessity of a call beyond 10s. per share, will give each shareholder an interest in the future of the undertaking, and will extinguish the further liability of £1 10s. per share."

Notice of Removal.—Messrs. Gwynne and Co., have removed from the Essex Street Works, Strand, to larger and much more convenient premises in Brooke Street, Holborn, E.C.

NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

The *Scotsman* to-day publishes the first of a series of articles upon electric lighting, the preface to which is that "now that we are within measurable distance of a public electric lighting installation, it is worth while to realize that no deep knowledge of electricity is required to enable the average citizen to follow discussions on the subject, or to count the cost in the event of his adopting the light." The author, it is understood, is Lord Justice-Clerk Macdonald, who is an authority on electrical matters, or his son, who is an advocate at the Scotch bar. Whoever he is, the writer shows that, whatever he may know about electricity, he has, or displays, "no deep knowledge" of lighting when he comes to compare the cost of electric with gas lighting. He takes electricity at 5d. per unit of 1000 watt-hours, and lays down the rule that "12,000 watt-hours will keep a 60-watt lamp alight for 200 hours—just the time that 1000 cubic feet of gas will supply 5 cubic feet an hour; and in practice, the 16-candle power lamp gives as much light as the average 5 cubic feet gas-burner." He then brings out the cost of electricity at 5s. 5d., as compared with gas at 3s. 6d. Without going into his calculation, it is sufficient to demolish his reasoning to point out the mix-up which he makes of the theoretical and the practical. His calculations as to hours, quantities, and costs are correctly made, as far as theory is concerned; and if he had not used the expression "and in practice the 16-candle power lamp gives as much light as the average 5 cubic feet gas-burner," there would have been no need to mention his writings here. But his practice is wrong at both ends. As a matter of fact, the 16-candle power electric lamp does not give the light nominated—as, indeed, he himself shows by a later paragraph—whereas gas supplies the light which it is provided to give. On the other hand—and this is his most serious slip—he takes the light of gas at 16 candles, which, considering that he was writing for Edinburgh readers, is a mistake. Five cubic feet an hour of Edinburgh gas gives a light of from 25 to 26 candles—that is, one-third more than even the nominal light of his electric lamp. Adding one-third to his price of electricity, we have, "in practice," 7s. 2½d. to produce the same light as can be got in Edinburgh from gas at the present price of 3s. 9d. per 1000 cubic feet, or just about double the price of gas. Notwithstanding his vaunt that "the convenience of well-arranged switches for electric light courts economy," there is an economy in the use of gas which cannot be experienced with electricity—namely, that, when a place is lighted by the latter, you must take the full power of the light, whereas with gas the consumer may take any quantity he likes. For instance, an electric lamp burning 200 hours will take 12,000 watt-hours; but an average gas-burner will consume only 2 cubic feet per hour, and the equivalent 1000 cubic feet of gas will burn 500 hours. Where the saving in practice comes in, is that you can make the same amount of light go 2½ times further with gas than with electricity, which is, or ought to be, a consideration with those who propose to adopt electric lighting. Anyone adopting electric lighting on the faith of the figures given in the article, would be likely to find, "in practice," that the cost would not square with the beautiful theory laid down by the author.

A statement appears in the *Glasgow Herald* of yesterday with reference to the complaints which I mentioned last week as being made by gas consumers, of the Corporation making the increase in the price of gas retrospective. Though not stated, the paragraph has the appearance of being a communication from someone connected with the Gas Department. Viewed as such, it is not quite satisfactory, as it does not touch the right and wrong of the question, but merely explains away the step which the Corporation took on the ground of expediency. The explanation given is, that "during the last twenty-two years the rate has been advanced on only three occasions; while it has been reduced no fewer than fourteen times. If consumers, therefore, have suffered by the increased price being charged retrospectively, they have benefited to a much larger extent by the decreases also partaking of that character. It need hardly be said that, in connection with the reductions, no one complained of being undercharged. It must also be obvious that, if the increase was to take effect only from the date of approval by the Town Council, the rate would have to be advanced proportionately in order that the necessary revenue might be obtained. The result to consumers, therefore, would remain very much the same." That is quite true as regards consumers generally; but it is quite possible to imagine a case where the result would be entirely different. Expediency is all very well, but a large legalized undertaking like the Glasgow Gas Trust must proceed upon firmer ground.

The new Treasurer of the City of Aberdeen is desirous to encourage economy; and one of the first things he has taken up is the question of the Corporation procuring a steam-boat for the carriage of the coal for the gas-works. He has given notice of motion to consider the question at the next meeting of the Council. If it is resolved to take such a step, which is highly improbable, the proceeding will be an innovation in gas management, so far at least as Scotland is concerned.

A Committee of the Dundee Police Commission have, in the course of inquiry prior to enforcing regulations for the lighting of common-stairs and back courts, made a perambulation of the city. Their work should be a profitable one to the Police Commission, for they have discovered that, out of about 800 lamps which are kept alight for the lighting of private property, only about 150 have been charged for. This means that the Police Commissioners have been paying for the lighting of private property to an extent which they cannot allow to go on. As the rate for each lamp varies from 5s. to 30s. a year, there should be a considerable increase of revenue from this department.

Mr. Main, the Superintendent of Police in Leith, has prepared a report to the Town Council on the subject of the lighting of common stairs and passages. He finds that there are 2488 such lights required in the burgh; and his proposal is that the Corporation should become responsible to the Gas Commissioners for the amount of gas consumed, charging it upon the owners, and that the Corporation should also undertake the extinguishing of the lights, charging the cost upon the occupiers. The lights should burn from sunset to sunrise. He thinks

that a burner to consume one cubic foot of gas per hour would be sufficient. A special staff of lads above 14 years of age could be employed to extinguish the lights. These could be got from 7s. a week each; and the cost upon occupiers would be about 2s. 6d. per light.

Time is passing, and the electric lighting installation of Glasgow is yet a good way from being completed. It was at one time expected that part of it would be in operation before the new year, but that expectation is not now generally entertained. There are observant people on all newspapers; and this week one of them wrote in an evening paper that a very serious hitch had occurred. This, according to the authorities, is altogether erroneous. The statement was considered to be of so much importance that it was contradicted by Mr. Arnot, the Electrical Engineer, by a letter to the newspapers; and at the Town Council meeting yesterday, Mr. Ure, the Convener of the Gas and Electric Lighting Committee, was called upon by the Chairman to give an explanation regarding it. The explanation was that, in some places where the crowns of cellars are near the surface, it has been found impossible to lay iron troughs for the copper strip, and the copper has had to be laid in the roadway. Where this occurs, iron pipes have had to be substituted for the troughs, because the latter would be unfit, at the shallow depth at which they are laid, to bear the heavy traffic on the streets. These pipes are, of course, unsuitable for the carriage of several bare copper strips; and where they are laid, the conductors are converted into insulated cables. I am not sufficiently versed in electrical engineering to say what the effect of a series of these transformations from strip to cable and from cable back to strip will be; but to the lay mind, it does look as if it will not be to the advantage of the installation, because of the possibility of current being lost at these junctions. It seems to me it would have been better to have had a uniform system throughout for carrying the current.

The Glasgow installation is housed in a handsome building at the corner of Waterloo and Main Streets—quite a central position for the supply of the district. Five steel boilers, of the marine type, 10 feet by 12 feet, supply steam to seven of Willans's central-valve compound engines—two of 80, two of 150, and three of 250 horse power—which, in turn, are employed to drive seven continuous current simple shunt-wound dynamos. Two of the dynamos have an output of 400 ampères, at 120 volts; two of 400 ampères, at 230 volts; and three of 670 ampères, at 230 volts. The plant is intended to supply 12,000 8-candle power lamps; but there is space in the building for additional plant to supply up to 40,000 lamps. The current is to be continuous low tension, at 200 volts, with a sub-divided circuit of 100 volts. The copper-strip conductors are 1 inch wide and ¼ inch thick. They are laid on porcelain insulators in cast-iron troughs, 22 inches wide and 6 inches deep. The troughs are water-tight; but provision is made for drawing-off water at man-holes, or, if necessary, by connections with the sewers. Four miles of culverts have been laid; and there will be about three miles more of cables in pipes. Where street lighting is to be introduced, the lights—106 in number, of 2000-candle power each—will be placed on columns, at a height of 18½ feet.

The Finances of the West Bromwich Gas Department.—A deputation from the Gas Committee of the West Bromwich Town Council has recently had an interview with the President of the Local Government Board with regard to the repayment of a loan of £23,500 for the purposes of the gas-works undertaking. As a result, the period sanctioned for repayment has been extended from 25 to 30 years.

The Agitation among the Gas-Workers at Keighley.—The discontent among the Keighley gas-workers may be said to have come to an end. After an interview with the President and Secretary of the Gas-Workers' Union, the Corporation Sub-Committee have conceded the men's principal demand, that of employing two more stokers to assist in the work, and the men with practical unanimity expressed themselves satisfied with the concession.

Sales of Shares.—At a sale by auction at Maidstone last Thursday week, a few £10 shares in the *Maidstone Water Company* realized £25 each.——On Thursday, at a sale at Exmouth, £10 "A" shares in the *Exmouth Gas Company*, earning 10 per cent., were disposed of at from £19 17s. to £20 2s. 6d.; and £10 "B" shares, paying 7 per cent., realized £17 12s. 6d. and £18. £10 shares in the *Exmouth Water Company* produced £19 12s. 6d.; and from £3 to £3 5s. was given for £5 shares in the *Budleigh Salterton Gas Company*, on which a dividend of 2 per cent was paid last year.——At the Auction Mart, Tokenhouse Yard, E.C., last Wednesday, Messrs. Edwin Fox and Bousfield sold 50 ordinary 10 per cent. fully-paid £10 shares in the *West Kent Gas Company* at £20 per share; and 35 7 per cent. £10 shares (£4 paid), at £7 per share. At the same place, on Friday, Messrs. G. A. Wilkinson and Son offered for public competition £25,000 of 5 per cent. perpetual debenture stock of the *South Metropolitan Gas Company*. It was put up in parcels of £500, £200, and £100. The highest offer per £100 of stock was £142 15s.; the lowest, £141 15s.—the average being £142 6s. 10d. The total amount realized by the sale was £35,585 10s.

Improved Street Lighting at Leeds.—In moving the confirmation of the proceedings of the Lamp Committee, at the meeting of the Leeds County Council last Wednesday, Mr. Pickersgill stated that, with the view of improving the lighting of the main streets, the Committee had decided that 40-candle power Bray lamps be substituted for those at present in use. It had been thought that the electric light might take the place of the gas-lamps. But the Committee did not think it would be the best thing to light the streets by electricity at present; and they therefore decided that they would place 40-candle power Bray lamps in most of the principal streets. They might have to increase the lamp-rate; but they hoped not. The number of Bray lamps they proposed to erect at present was nearly 300. The cost of gas would not be much. He did not suppose it would be more than £250 per annum. A few years ago the Gas Committee supplied gas to the Lamp Committee at 6d. per 1000 cubic feet; and this was a very great boon. In 1886 the lamp-rate was about 2d. in the pound; and they paid the Gas Committee £2375 a year for gas. Now they had to pay 2s. 2d., and get a discount the same as other consumers; the amount now paid being £13,124. He contended that they ought to have gas at a less figure than other consumers; there being 9934 lamps in the borough. The resolution was unanimously carried.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *Dec.* 10.

Sulphate of Ammonia.—The market has been somewhat irregular, in consequence of speculative manœuvres with a view to a decline in prices. Values have, however, not changed much; and although business has been reported at £10 to £10 1s. 3d. at Hull and Leith, it may be taken as admitted that only second-hand parcels have changed hands at these prices. Makers offer but sparingly; and there is not much difficulty in finding buyers for the spot parcels offering, while, in view of the strengthening nitrate position, producers are hardly justified in selling beyond their present output. At the close, £10 2s. 6d. is generally quoted. As regards nitrate, it is stated that the statistical figures at the close of this month will exhibit a considerable deficiency in the visible supply, which is now unlikely to be materially increased; and that, assuming the consumption on the basis of former years, values must become largely enhanced towards the consuming season.

LONDON, *Dec.* 10.

Tar Products.—Very little actual business is being done. There is a good inquiry for benzol; but makers are looking forward to better prices, though it is doubtful if they will be obtained, if the report be true that the production from the coke-ovens on the Continent will be enormously increased in the early part of next year. Carbolic acid is selling more freely; and the value is considerably improved, as will be seen by the quotation below. Creosote and common oils are dull. Pitch, curiously, is realizing more money in the provinces than at this port. It is stated that this anomalous position has been brought about by speculative operations of dealers. Anthracene is well held; but no new business appears to be doing. Alizarine makers declare they cannot pay the price now asked by makers; but, as the alizarine trade seems to be looking up, they may be compelled to do so. To-day's prices are: Tar, 10s. to 11s. Pitch, 27s. to 30s. Benzols, 90's, 1s. 7d.; 50's, 1s. 4d. Toluol, 1s. 2½d. Solvent naphtha, 1s. 1½d. Crude benzol naphtha, 30 per cent., 7½d. Creosote, 1¼d. Creosote salts, 18s. Pressed naphthalene, 42s. 6d. Carbolic acid, 60's, 1s. 7d.; 70's, 1s. 9d.; crystals, 6d. Cresol, 1s. Anthracene, 30 per cent., "A," 1s. nominal; "B," 9d. nominal.

Sulphate of Ammonia.—This market is in a much more satisfactory condition; and business is being done freely at £10 to £10 2s. 6d., less 3½ per cent., for spot, and £10 5s., less 3½ per cent., for forward delivery. Gas liquor, 6s. to 7s. per ton.

COAL TRADE REPORTS.

Lancashire Coal Trade.—Except that the cold weather of the past week has brought forward a more active inquiry for the better qualities of round coal, there is no improvement to notice in the coal trade of this district; and many of the collieries are still working short time. Prices show more firmness for house-fire qualities, sellers being less ready with concessions. Best Wigan Arley coals do not average more than 12s. 6d.; Pemberton four-feet and second qualities of Arley, 10s. 6d.; and common house-fire coals, 8s. 6d. per ton, while orders might still be placed at considerably under these figures. Common round coals remain in very indifferent demand, both for inland requirements and for shipment. At the pit mouth, steam and forge coals are quoted at from 7s. to 7s. 6d. per ton; while for delivery at the Garston Docks or the High Level, Liverpool, ordinary descriptions of steam coal are not fetching more than 8s. 3d. to 8s. 6d. per ton. It may be added that the agitation now going on in South Wales, with reference to discontinuing the sliding-scale arrangement, is being watched with considerable interest here. It is felt that the South Wales coalowners have been indifferent about keeping up prices, as by means of the sliding scale, they have been enabled to obtain corresponding reductions in wages, which in other districts could only be enforced after a severe struggle with the Miners' Federation. As a consequence, Welsh coal has been pushed at extremely low figures at the ports on the Mersey, much to the detriment of Lancashire trade. Good qualities of burgy, at the pit mouth, average 6s. to 6s. 6d.; the better qualities of slack, 4s. 9d. to 5s. 3d.; and the lower qualities, 3s. 6d. to 4s. 6d.

Northern Coal Trade.—There has been a larger volume of trade done in coal in the North-east of England of late. Shippers have desired to get quantities quickly away; and the wintry weather has decidedly quickened the demand, both for household and gas coal, though the prices have not responded. Best Northumbrian steam coal is steady at 9s. per ton f.o.b.; but the demand for second-class sorts is weaker. Smaller steam coal is about 3s. 9d. per ton. Bunker coal is very much depressed, with a decreased consumption. Very large contracts have been placed for locomotive coal at prices varying from 7s. 3d. to 7s. 9d. per ton at the pit—considerably less than the rates paid under the expiring contracts. Manufacturing coals have also been freely sold at lower prices over next year. In gas coal, prices have not varied. Contracts for one of the largest gas companies in the North are now in course of negotiation; and it is certain that the price will be much below that at which the last contracts were arranged. There is little or no alteration in smithy or other kinds of coal. Coke is well sold at unchanged prices—about 13s. 3d. per ton for blast furnace qualities, delivered at the local furnaces; while for shipment, about 15s. is the current price. Gas coke is fairly steady for prompt shipment; but the larger of the contracts for next year's consumption do not seem to have been yet agreed upon.

Scotch Coal Trade.—Cold weather has made an increased demand for household coal; but otherwise there is not much encouragement for coalowners in the market at present. A contract for 15,000 tons of main for Bilbao, to be delivered in the course of next year, has been secured in the Glasgow district, at the low price of 11s. per ton c.i.f. In shipping, business is being drawn off to Welsh and North of England ports, where the prices are very easy. The shipments for the week amounted to 140,507 tons—a decrease upon the quantity shipped in the previous week of 10,464 tons, and an increase of 980 tons over the corresponding week of last year. For the year to date, the total shipments have been 7,175,089 tons—an increase over the same period of last year of 907,361 tons. The prices quoted are: Main, 6s. 9d. to 7s.; ell, 7s. 6d. to 7s. 9d.; splint, 7s. 3d. to 7s. 6d.; and steam, 9s. to 9s. 3d.

The Water Scheme for Penrith.—In the JOURNAL for May 31 last, we referred to a report, prepared by Mr. G. F. Deacon, on a water scheme for Penrith, the estimated cost of which he placed at £8000. Since then the question has developed to an important extent; and he has now suggested an alternative scheme, which it is computed will cost slightly in excess of £12,000.

Paris Water Supply.—According to the Paris correspondent of *Industries*, the proposal of M. Durillard to supply Paris with water from the Lake of Geneva is being discussed. Since the cholera epidemic, the dangerous nature of the present water supply has drawn attention to the scheme. M. Durillard proposes to pump 500 million gallons of water per day from the Geneva Lake on the French side up to the plateau of Chatillon, which is about 328 feet above the sea-level, and then an aqueduct about 340 miles long will convey the water to the French capital. The estimated cost is £20,000,000; and the works could, it is stated, be completed in from six to eight years.

More Work with the Divining-Rod.—A correspondent of the *Illustrated Carpenter and Builder* gives an account of a successful attempt to find water by divination lately made by Mr. J. Stears, of Hull. In order to supply some small cottage property with water, the writer sunk a well to a considerable depth; but he only came on solid rock. He was relating his experience to the Surveyor of an adjacent town, when this gentleman suggested calling in Mr. Stears. This was done; and the process of walking leisurely over the ground beneath which water was supposed to be, with a forked thorn held before him, was gone through. The correspondent states that, as soon as the "diviner" came over the spot where there was water, the rod began to move upwards until it nearly touched his breast. The ground was opened at that place; and water was found at a depth of only 21 feet.

Extensions at the Caterham Gas-Works.—The Caterham Gas Company have recently extended their storeage plant by adding a 50 ft. by 18 ft. gasholder, with cup provided for a second lift, and guide-framing for the full height of two lifts. It was built by Messrs. S. Cutler and Sons. The tank is of concrete, 53 feet in diameter and 18 ft. 6 in. deep, and was constructed, from the design and under the supervision of Mr. G. W. Anderson, Assoc.M.Inst.CE., the Company's Manager and Secretary, by Messrs Hunter and Bryant, of Warlingham. It is a thoroughly substantial job, being perfectly tight. A new tar-well has also been built; and a washer and weigh-bridge procured and fixed. Next spring it is contemplated to relay the principal portion of the trunk main into Caterham Valley, which is much too small for its work. At present a pressure of 40-10ths has to be given at the works in order to obtain 14-10ths in the Valley, which is 139 feet higher than the works. When this main has been laid, Mr. Anderson hopes that a maximum pressure of 15-10ths to 18-10ths at the works will be sufficient; and he expects a very considerable saving in leakage will be the result.

Opening of the Museum of Sanitary Appliances at Highgate.—Last Thursday, the Museum of Sanitary Appliances established by the Hornsey Local Board, to which reference was made in the JOURNAL last week, was formally opened by the Lord Mayor (the Right Hon. Stuart Knill). He was received by the Chairman (Mr. H. R. Williams) and Members of the Board, the Engineer and Surveyor (Mr. T. De Courcy Meade, M.Inst.C.E.), and other officials. In asking his Lordship to open the exhibition, the Chairman said that the initiation of the museum was due to their Engineer, Mr. Meade. Such institutions ought, he thought, to be founded all over the country, and then sanitary science would not be so imperfectly understood as at present. Hornsey and its Board were very progressive; and there was no exhibition of the kind in the neighbourhood of London. The Lord Mayor said the exhibition had far exceeded his anticipation; and the instruction it afforded would be invaluable. The health and happiness of the people were of paramount interest to all; and everything that tended to increase public knowledge on the subject of sanitation should be encouraged. He believed the museum would be a great success; and he had pleasure in declaring it open. Sir R. Rawlinson moved a vote of thanks to his Lordship; and it was cordially adopted.

Proposed Constant Water Supply for Barnet.—On Wednesday, the 30th ult., Colonel Ducat opened, at New Southgate, an enquiry, on behalf of the Local Government Board, respecting an application made by the Friern Barnet Local Board to have a constant supply of water furnished in their district by the Barnet Gas and Water Company, and to have added to the regulations of the Company in this respect a proviso that owners of houses now served with water should not be called upon to alter them, unless it could be shown that they led to waste. There was a large attendance of parties interested in the matter. Colonel Ducat was assisted by General Scott. The proceedings were briefly opened by Mr. Lyon, Barrister, who, on behalf of the Company, expressed his desire to facilitate the inquiry in every possible way. Mr. E. Goodship then stated the case for the Board, and explained the causes which had led to the investigation, and stated the reasons for asking for a constant supply. He called Mr. F. J. Brazier, a registered plumber, who said he had examined a number of houses which he thought were fairly representative of the entire parish; and, in his opinion, the existing fittings were sufficiently strong to bear the strain of a constant service. Mr. Lyon then addressed the Inspector. He asked him to take into consideration the peculiar configuration of the district, and the fact that it stood 460 feet above Ordnance datum, and very arid. He also dwelt upon some of the disadvantages of a constant supply both to the Company and the consumers. He called the Company's Engineer (Mr. T. H. Martin, Assoc.M.Inst.C.E.), who stated that the present average supply of water was 23 gallons per head per day; but under the constant system it would be about 60 gallons. The shortest time for which water was turned on was two hours; but in summer it was sometimes on for five hours. He believed that the old service-pipes would not sustain the pressure of a constant supply. Mr. Martin was under cross-examination by Mr. Goodship when, to suit the convenience of the Inspector, the inquiry was adjourned till after Christmas. In the course of the proceedings, a consumer in attendance caused much amusement by vigorously attacking the Board's proposal, which he stigmatized as a "fad" of a few of the members, who, if they had a chance, would, he said, "lay water on to the moon."

Proposed Purchase of the Abertillery Gas and Water Works by the Local Board.—The Abertillery Local Board are negotiating for the purchase of the property of the local Gas and Water Company. The Directors appear to be willing to part with the works, and have promised to name a price at an early date.

Southport and the Electric Light.—Colonel Hastead, R.E., one of the Local Government Board Inspectors, held an inquiry at Southport last Thursday into the application of the Southport Town Council to borrow £28,000 for electric lighting purposes. It is intended to provide for 6600 16-candle power lamps; but the demand at present is not expected to exceed 1900 lamps. There was no opposition.

New Water-Works at Shipley.—The Shipley Local Board have just completed the works connected with a new high-level water service; and last Wednesday week the water was turned on for the first time by Mr. S. Rushworth (Chairman of the Water Committee) in the presence of a number of members of the Board and others. The estimate of the probable outlay on the undertaking, which is designed for the supply of the high-lying portions of the district, amounted to £10,000; and it is stated that this sum will not be exceeded to any serious extent. One of the chief objects aimed at in constructing the new service was to enable the Board to supply a part of the district of Windhill which has lately been included in the local government district of Shipley. Hitherto the supply of water to Windhill has been obtained from the Bradford Corporation; but the contract between the old Windhill Local Board and the Bradford Corporation expires at the end of this year. By taking over this supply, it is calculated that the Shipley Board will benefit to the extent of about £1000 a year. Messrs. W. B. Woodhead and Son, of Bradford, were the Engineers for the undertaking, and Mr. J. Bairstow contracted for the whole of the work except the iron pips, which were suppliede by the Clay Cross Company.

The West Bromwich Town Council and Electric Lighting.—At the meeting of the West Bromwich Town Council last Wednesday, under the presidency of the Mayor (Mr. C. Akrill), the Estates Committee reported that they had received a report from the Borough Surveyor upon the subject of lighting the Town Hall, Municipal Offices, Free Library, and Institute by electricity; and they recommended the Council to authorize them to obtain specifications and tenders for the work. Mr. Garratt moved the adoption of the report, and referred to the benefits likely to result from the proposal. Mr. Pitt moved, as an amendment, that the question be postponed for twelve months. He argued that the time was inopportune; and that the expenditure would mean 3d. in the pound on the borough rate, which was now 5d. in the pound. Two Committees had, he said, already overspent their estimates by £1463; and in one year and eight months, the Council's capital expenditure had been £42,000. It would also be taking £250 each year from the Gas Committee, who now found it hard to make ends meet; and they could not expect any profit next March from the gas undertaking for the relief of the rates. A long discussion ensued, in which it was contended that the scheme would cost £3000; and that, for various reasons, it would be better left in abeyance. The amendment was carried by 12 votes to 8.

Gas and Electric Lighting at Teignmouth.—Last Wednesday a public meeting was held at Teignmouth to consider the questions of the extension of the gas-works and the introduction of the electric light. The Rev. A. Cartwright, the Chairman of the Local Board, presided, and stated that it was very necessary there should be an extension of the means of lighting in the town; the gas-works being very deficient in their producing capacity. During the last two years, the make of gas had increased from 16 million cubic feet per annum to 23 millions. They were distributing 120,000 cubic feet of gas per day; and the storeage capacity was about 65,000 cubic feet. This meant that, if by any unhappy chance the gas-works were stopped for more than half a day, the town would be in absolute darkness. The Local Board had had before them two schemes for enlarging the gas-works. The most complete, and that which, if there were no chance of any other light being introduced, would in the long run be undeniably the cheapest, would cost £16,000. The other scheme, which would be sufficient provision for 15 or 20 years, would cost £10,000. The Board had also had before them two schemes for lighting the town by the electric light, one of which would cost £8500; and the other £15,000. The Rev. R. D. Maxwell moved a resolution appointing a deputation to confer with the Local Board on the above questions, to ascertain to what extent the ratepayers would be willing to adopt electric lighting, and to report to an adjourned meeting. This was unanimously agreed to.

Alleged Breach of the Public Health (London) Act.—At the South-Western Police Court last Wednesday, Mr. Plowden heard a summons against the Southwark and Vauxhall Water Company for failing to give a notice in writing to the Vestry of St. Mary, Battersea, as the Sanitary Authority, of their intention to cut off the supply of water to a certain house at No. 71, Mallison Road. Mr. W. W. Young, who supported the summons on behalf of the Vestry, admitted that the Company had a good cause for cutting off the supply; but he pointed out that the Public Health (London) Act required these proceedings to be taken. The tenant of the house was called, and said she was without water for some days. Mr. Horton, barrister, who represented the Company, argued that the shutting down of a stopcock for temporary repairs was not cutting off a supply of water within the meaning of the Act in question. This was done, he proceeded to say, to prevent the house being flooded. It was not a hostile cutting off, but a friendly one. The water could have been obtained at once if the stopcock had been turned on; and this could have been done by the tenant with her own key. Evidence was adduced to prove that it was to the interest of the tenant to have the water stopped. Mr. Plowden, in dealing with the case, said he was of opinion that the Company had no intention of withdrawing the supply of water from the tenant's house. What they did was from over-zeal; indeed, it was a labour of love. He dismissed the summons; but as the Vestry had no choice but to take the proceedings, he would not grant costs. Mr. Young applied for a case for a Superior Court. Mr. Plowden acceded to the application; remarking that the case was one of considerable importance.

Electric Lighting for Redruth.—An electric supply company is proposed for Redruth with a capital of £10,000; but before issuing their prospectus, the promoters are endeavouring to gauge the amount of support they are likely to receive. The inhabitants have been informed that the electric current will be furnished at the same price as gas at 4s. 6d. per 1000 cubic feet (*light for light*); but as soon as the Company have 2000 lamps connected to their system, they will be able to supply at a very much cheaper rate.

The Price of Gas at Accrington.—The difficulty which has arisen at Accrington between the Gas Company and a number of the larger consumers, regarding the increase in the price of gas by 5d. per 1000 cubic feet, still attracts a great deal of attention in north and north-east Lancashire. The Company are enforcing the payment of the increase under threat of cutting off the supply; and the Co-operative Society, with others, have paid their accounts "under protest." Meanwhile, the Corporation are awaiting Counsel's opinion as to the legality of the Company's notice for the increase on the past quarter's account, and the neighbouring Local Boards will abide by this decision.

The Artesian Well at Aldgate.—At a recent meeting of the London Commissioners of Sewers, the Medical Officer of Health (Dr. Sedgwick Saunders) reported the completion of the artesian well at the artisans' dwellings in the Minories; and he stated that, as to purity, the well continued to yield water of a high standard of excellence. It was absolutely free from organic pollution. Bearing in mind the evidence recently given before the Royal Commission on the Metropolitan Water Supply, as to the character and quality of the water yielded by the deep wells in the Thames district, it would, he said, be interesting if accurate and continued observation were kept upon the height of the level of the water in the new well, and the results tabulated with the rainfall and other data. These particulars would, in his opinion, be of great service in a scientific sense.

An Electric Light Installation for Stafford.—A report recommending that active measures should be taken to provide an installation of electric lighting in the borough was submitted to the Stafford Town Council last Tuesday. Alderman Peach, in moving its adoption, pointed out the fact that the Council had a capital of £100,000 bound up in the gas-works, and that the period for which the Provisional Order for electric lighting was granted to the Corporation having expired, a private company would step in, unless the Corporation took immediate action. The cost of an installation of 3000 lights would be £20,000. It would require 2000 lamps to make the scheme pay; and with the County Council, the Post Office, and private consumers who were prepared to take the light, there was reason to believe that 1500 lamps would be connected with the system from the start. The effect on the consumption of gas, even if 3000 lamps were supplied, would be but the slightest; and the monopoly of the Corporation would be preserved. The report was adopted.

Arbitration Proceedings in Connection with the New Water-Works for Morley.—Three days were recently occupied in arbitration proceedings with respect to claims for compensation made by Messrs. Fielden against the Morley Corporation for certain lands required in connection with the construction of the new reservoir at Withens. The Umpire was Mr. J. W. Fair, of Wigan; and a number of legal gentlemen and surveyors and valuers were engaged in the matter. There were three cases, which were considered separately. The first taken was a claim made by Mr. J. A. Fielden; and his witnesses placed the amount of the compensation which he ought to receive at £1834, while those for the Corporation were of opinion that about £453 would be ample. The next claim was that of Mr. John Fielden; the valuation put in on his behalf being nearly £2000, while on the other side £1103 was fixed as an adequate amount. The third case was a joint claim by Messrs. Fielden for £1022; the estimated value put in for the Corporation being about £259. The award will be given in due course.

Palermo Water Supply.—According to the *Financial News*, the Palermo Water-Works scheme has entered on a new phase. The concession was originally granted, three years ago, to Mr. J. Lawrence, who acted in conjunction with Messrs. Redfern, Alexander, and Co. The Baring catastrophe forced the concessionnaires to postpone indefinitely the bringing forward of the duly-registered Palermo Water-Works Company. Since then, the failure of Messrs. Redfern, Alexander, and Co. rendered the task still more difficult; and the Municipality has now forfeited the deposit of £12,000 (of which a large portion was contributed by others), and has granted a new concession to certain Italian engineers. Our contemporary is informed that the terms of this new grant, though in some respects rather more favourable to the concessionnaires (as the municipal subvention is increased from 4,000,000 to 4,500,000 lire), are in others so onerous as to make it highly improbable that any English capitalists or contractors would accept them. Hope is expressed, however, that the scheme will be carried out, as the water supply at Palermo is at present in a condition which is not only a disgrace to a city of 300,000 inhabitants, but a positive danger to the rest of Europe, and more especially to England.

The New Water-Works for Stainland.—A short time ago, Mr Arnold Taylor, one of the Inspectors of the Local Government Board, held an inquiry at Stainland, relative to an application by the Local Board for power to borrow a further sum of £6500 for water supply works. The Clerk (Mr. Longbottom) stated that it was proposed in the first instance to construct a reservoir at Coldacre to contain 3,500,000 gallons. Such a reservoir would have cost, including site, about £7000. Afterwards it was considered expedient to make the reservoir large enough to hold 4,500,000 gallons; the estimated expenditure being increased to £10,000. When this was communicated to the Local Government Board, they suggested that provision should be made for 150 days' supply, or 6,000,000 gallons. This meant extra expense. Two farms had had to be purchased, at a cost of £830 and £430 respectively; and also certain easements, at a cost of £235. As regarded the expenditure on land and permanent works, estimated at £9000, they asked for permission to extend the repayment over the full period of sixty years. The Inspector observed that the explanation why the money was wanted was so clear that in all probability the Local Government Board would have granted it at once, but for the fact that the amount asked for would increase the Local Board's outstanding debt to over one year's assessable value of the district.

Reading Corporation Water-Works.—The Water Committee of the Reading Town Council have received the sanction of that body to the expenditure of £2492 in improving the pumping machinery at the Bath Road works.

Electric Lighting for Worcester.—Last Tuesday, the Worcester City Council adopted a recommendation of the Watch Committee to obtain a loan with which to purchase the Powick Mills and the land adjoining for the sum of £5000 for the purpose of an electric lighting station, and to enter into a contract with the Brush Electrical Company, the total expenditure to amount to £31,000.

An Artesian Well at Leighton Buzzard.—An artesian bored tube-well has just been completed by Messrs. C. Isler and Co., of London, at Leighton Buzzard. It is 144 feet deep, and the boring passed through the gault into the lower greensand formation; tapping powerful springs, and yielding a minimum supply of 290,000 gallons of water, which Professor Attfield and Dr. Muter report as being remarkably pure.

The Purification of the Water Supply at Worcester.—A six months' trial of the Revolving Purifier Company's process has recently been completed at the water-works of the Worcester Corporation; and Dr. Dupré has tested its working, on the agreement that, if successful, the Council should enter into a contract with the Company and take over the works. In a report on the subject, Dr. Dupré states that he found the Severn water was peaty in colour, which is not a sanitary disadvantage; that though a million gallons of sewage enters the Severn above Worcester, throughout the 13 miles between Worcester and Stourport (in which there are three weirs) the water is well aërated until close to the outfall at Stourport; and that there is no sanitary danger in the Severn water, except in a time of serious epidemic. Dr. Dupré advises the Council to adopt the process, in case they are willing to adequately increase the filtering area and storeage capacity of the works; and after the execution of the additional works, the Severn will give a good supply of potable water. The matter came before the City Council last Tuesday; and, after considerable discussion, it was resolved to ask the Company to continue the experiment for a further six months.

GAS AND WATER COMPANIES' STOCK AND SHARE LIST.

(For Stock Market Intelligence, see ante, p. 1031.)

Issue.	Share	When ex-Dividend.	Dividend or Div. Rate.	NAME.	Paid per Share	Closing Prices.	Rise or Fall in Wk.	Yield upon investment.
£			p. c.	GAS COMPANIES.				£ s. d.
590,000	10	14 Oct.	10½	Alliance & Dublin 10 p. c.	10	16—17	..	6 3 6
100,000	10	"	7½	Do. 7 p. c	10	10¾—11¼	..	6 10 5
300,000	100	1 July	5	Australian (Sydney) 5 % Deb.	100	105—107	..	4 13 4
100,000	20	30 Nov.	8	Bahia, Limited	20	11—12*	..	13 6 8
200,000	5	16 Nov.	7½	Bombay, Limited	5	6—6½	..	5 15 9
40,000	5	"	7½	Do. New	4	4—4¼	..	6 13 4
380,000	Stck.	12 Aug.	12½	Brentford Consolidated	100	212—217	..	5 12 10
150,000	"	"	9½	Do. New	100	163—168	..	5 10 1
220,000	20	15 Sept.	11½	Brighton & Hove Original	20	40—42	..	5 9 6
888,500	Stck.	31 Aug.	5	Bristol	100	103—106	..	4 14 4
320,000	20	29 Sept	11½	British	20	40—42	..	5 7 1
50,000	10	31 Aug.	11½	Bromley, Ordinary 10 p. c.	10	19—20	..	5 15 0
51,510	10	"	8½	Do. 7 p. c.	10	14¼—15½	..	5 9 8
328,750	10		—	Buenos Ayres (New) Limited	10	7⅞—8¼	—⅛	—
200,000	100	1 July	6	Do. 6 p. c. Deb.	100	98—101	..	5 18 10
150,000	20	12 Aug.	8	Cagliari, Limited	20	25—27	..	5 18 6
550,000	Stck.	14 Oct.	13	Commercial, Old Stock	100	232—237	..	5 9 9
165,000	"	"	10	Do. New do.	100	180—185	..	5 8 1
162,762	"	15 June	4½	Do. 4½ p. c. Deb. do.	100	123—128	..	3 10 4
800,000	Stck	15 June	13	Continental Union, Limited	100	227—232	..	5 12 1
200,000	"	"	10	Do. 7 p. c. Pref	100	193—195	..	5 2 7
75,000	Stck.	15 Sept.	10	Crystal Palace District	100	185—190	..	5 5 3
486,090	10	28 July	10	European, Limited	10	19½—20½	..	4 17 7
354,060	10	"	10	Do. Partly paid	10	14—15	..	5 0 0
5,470,820	Stck.	12 Aug.	12	Gaslight & Coke, A, Ordinary	100	218—221	..	5 8 7
100,000	"	"	4	Do. B, 4 p. c. max.	100	95—98	..	4 1 7
665,000	"	"	10	Do. C, D, & E, 10 p.c. Pf.	100	259—264	..	3 15 10
30,000	"	"	5	Do. F, 5 p. c. Prf.	100	116—121	..	4 2 7
60,000	"	"	7½	Do. G, 7½ p. c. do.	100	166—171	..	4 7 8
1,300,000	"	"	7	Do. H, 7 p. c. max.	100	161—166	..	4 4 3
463,000	"	"	10	Do. J, 10 p. c. Prf.	100	257—262	..	3 16 3
476,000	"	"	6	Do. K, 6 p. c. Prf.	100	152—155	..	3 17 5
1,061,150	"	15 June	4	Do. 4 p. c. Deb. Stk.	100	118—121	..	3 6 1
294,850	"	"	4½	Do. 4½ p. c. do.	100	123—127	..	3 10 10
908,000	"	"	6	Do. 6 p. c. do	100	165—170	..	3 10 6
3,800,000	Stck.	16 Nov.	12	Imperial Continental	100	222—225	+1	5 6 8
75,000	5	30 Nov.	6	Malta & Mediterranean, Ltd.	5	4—4½*	..	6 13 4
560,000	100	1 Oct.	5	Met. of Melbourne, 5p. c. Deb.	100	106—108	..	4 12 7
541,920	20	16 Nov.	5	Monte Video, Limited	20	14½—15½	..	6 9 0
150,000	5	30 Nov.	10	Oriental, Limited	5	8—8½*	..	5 17 8
60,000	5	29 Sept.	7	Ottoman, Limited	5	4—4½	..	7 7 4
166,870	10	—	2	Pará Limited	10	2—2½	..	—
420,000	100	2 Nov.	6	People's Gas of Chicago— 1st Mtg. Bds.	100	103—107	..	5 12 1
500,000	100	1 Dec.	6	2nd Do.	100	100—105*	..	5 14 3
150,000	10	—	10	San Paulo, Limited	10	8½—9½	..	—
500,000	Stck.	31 Aug.	15½	South Metropolitan, A Stock	100	287—292	..	5 6 2
1,350,000	"	"	12	Do. B do.	100	234—238	+1½	5 0 10
230,000	"	"	13	Do. C do.	100	243—248	+2	5 4 10
725,000	"	14 July	5	Do. 5 p. c. Deb. Stk.	100	140—144	..	3 9 6
60,000	Stck.	31 Aug.	11½	Tottenham & Edm'nton, "A"	100	225—230	..	5 0 0
				WATER COMPANIES.				
743,952	Stck.	1 July	10	Chelsea, Ordinary	100	247—252	..	3 19 5
1,720,252	Stck.	14 Oct.	8	East London, Ordinary	100	200—205	..	3 18 0
544,440	"	1 July	4½	Do. 4½ p. c. Deb. Stk.	100	140—144	..	3 2 6
700,000	50	1 July	8½	Grand Junction	50	105—109	+½	3 17 11
708,000	Stck.	12 Aug.	11	Kent	100	273—278	..	3 19 1
1,043,800	100	1 July	9½	Lambeth, 10 p. c. max.	100	220—225	+2	4 4 5
406,200	100	"	7½	Do. 7½ p. c. max.	100	192—196	+½	3 16 6
285,000	Stck.	29 Sept.	4	Do. 4 p. c. Deb. Stk.	100	123—128	+1	3 2 6
500,000	100	12 Aug.	12½	New River, New Shares	100	325—330	..	3 13 6
1,000,000	Stck.	28 July	4	Do. 4 p. c. Deb. Stk	100	132—135	..	2 19 3
902,300	Stck.	15 June	6½	S'thwk & V'xhall, 10p. c. max.	100	150—155	+2	4 3 11
126,500	100	"	6½	Do. D 7½ p. c. do.	100	135—140	..	4 12 10
1,155,066	Stck.	15 June	10	West Middlesex	100	241—246	..	4 1 3

*Ex Div.

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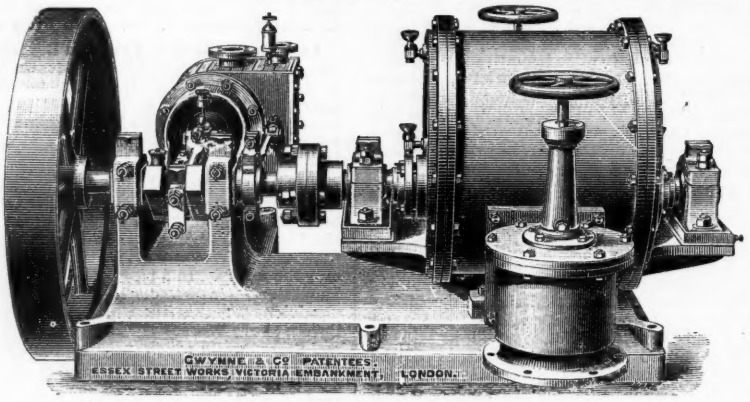

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THE Corporation of Liverpool are pre- pared to receive TENDERS for the purchase of 450 disused CIRCULAR LANTERNS, constructed of Zinc and Copper, with bent Glass sides. These Lanterns are in usable repair, and may be seen on application to the Storekeeper, Vine Street Yard, Liverpool.

Sealed tenders, marked "Tender for Lanterns," must be delivered at the City Engineer's Office, Liverpool, not later than Ten o'clock a.m., on Friday, the 16th inst.

The Corporation do not bind themselves to accept the highest or any tender, or to defray any expenses incurred by persons tendering.

By order,
GEORGE J. ATKINSON,
Town Clerk.

Municipal Offices, Liverpool,
Dec. 7, 1892.

MOLD GAS AND WATER COMPANY.

THE Directors of the above Company invite TENDERS for the following WORKS for the Water Supply of their District: Contract No. II., EXCAVATION for PIPE-TRENCH. Contract No. III., SERVICE RESERVOIR at Gwernymynydd, near Mold.

Drawings may seen, and a printed copy of the Specifications, Schedule of Prices, and Form of Tender can be obtained on payment of Ten Shillings (which will not be returned) on application at the Offices of the Company, Wrexham Street, Mold, between the hours of Ten a.m. and Five p.m. on any day (Sundays and Saturday afternoons excepted) prior to the date for the receipt of tenders.

Sealed tenders, on the form provided with the schedule of prices, to be addressed to the Chairman of the Company, endorsed "Tender for Pipe-Trench," or "Tender for Reservoir," are to be sent to the undersigned on or before Noon on Saturday, the 24th inst.

The Directors do not bind themselves to accept any tender.

By order of the Directors,
JAMES M'GREGOR,
Manager and Secretary.

Gas and Water Offices, Mold,
Dec. 7, 1892.

THE NEWLY-PATENTED BOWER REGENERATIVE GAS-LAMP.

VERY many thousands of Lamps under the old Patents sold, and four Gold Medals and other Prizes have been awarded to them in open competition; but the NEW LAMP *gives a much better light than the old one*, and is cheaper and more durable.

Particulars of GEORGE BOWER, St. Neots, HUNTS.

ALLIANCE AND DUBLIN CONSUMERS' GAS COMPANY.

THE Directors of the above Company are prepared to receive TENDERS from Ironmongers, Gun-barrel Manufacturers, Timber Merchants, Druggists, Rope Makers, &c., for GOODS to be delivered on the Company's Works, Great Brunswick Street, in such quantities as may be required from time to time up to Dec. 31, 1893.

Samples of Goods required are open to inspection on the Works, Great Brunswick Street, and printed lists of Articles required can be had on application at the Company's Offices, D'Olier Street.

Tenders, endorsed "Tender for Stores," to be lodged in my Office, on or before the 24th inst.

W. F. COTTON,
Secretary and Manager.

D'Olier Street, Dublin.

TO RETORT & FIRE-BRICK MANUFACTURERS.

THE Corporation of Birkenhead are pre- pared to receive TENDERS for RETORTS, FIRE-BRICKS, BLOCKS, and FIRE-CLAY required at their Gas-Works during the current Year.

Forms of Tender may be obtained from Mr. T. O. Paterson, C.E., Gas Engineer, Gas-Works, Thomas Street.

Tenders, sealed and endorsed "Tender for Retorts, &c.," to be sent in to me not later than Five o'clock in the Afternoon of Friday, the 23rd day of December, 1892.

The Corporation do not bind themselves to accept the lowest or any tender.

By order,
ALFRED GILL,
Town Clerk.

Town Hall, Birkenhead,
Dec. 7, 1892.

HARTLEPOOL GAS AND WATER COMPANY.

TO IRONFOUNDERS, ETC.

THE Directors of the above Company are prepared to receive TENDERS for the several Works and Materials required in the construction and erection of a RETORT-HOUSE ROOF, 73 ft. 8 in. wide, and 126 ft. 10½ in. long; also a ROOF for a COAL-STORE, 14 ft. 4 in. wide, and 106 ft. 10½ in. long, both internal measurements.

Plans and Specification may be seen, or any further information obtained, on application to the Company's Engineer, Mr. Thomas Bower, who, if desired, will supply copies of the plans.

Tenders, on form prescribed, and sealed and endorsed "Tender for Retort-House Roofs," to be sent to Mr. Thomas Trewhitt, Secretary, Gas and Water Company, West Hartlepool, not later than Wednesday, the 11th day of January next.

The Directors do not bind themselves to accept the lowest or any tender.

By order of the Directors,
THOMAS TREWHITT,
Secretary.

Gas and Water Company's Offices,
West Hartlepool, December, 1892.

EAST LONDON WATER-WORKS COMPANY.

NOTICE is Hereby Given, that the TRANSFER BOOKS in respect to the DEBENTURE STOCK WILL BE CLOSED on the 19th of December inst., and re-opened on the 2nd day of January, 1893.

By order,
I. A. CROOKENDEN,
Secretary.

St. Helen's Place, London,
Dec. 10, 1892.

TOTTENHAM AND EDMONTON GASLIGHT AND COKE COMPANY.

NOTICE is Hereby Given, that the TRANSFER BOOKS of this Company, so far as they relate to the DEBENTURE STOCK and BONDS, WILL BE CLOSED on the Evening of Thursday, the 15th of December inst., for the Half Year ending on the 31st of December, 1892, and that the Interest for that Half Year will be payable on the 2nd day of January, 1893, to the Proprietors registered as the holders of such Debenture Stock and Bonds at the time of such closing of the Transfer Books, which will be re-opened for the following Half Year on the Morning of Tuesday, the 20th of December inst.

By order of the Board,
JAMES RANDALL,
Secretary.

Gas Offices: Willoughby Lane,
Tottenham, Dec. 9, 1892.

PATENTS, DESIGNS, AND TRADE MARKS ACTS, 1883 TO 1888.

NOTICE is Hereby Given that Sarah Rachel Morris, of Bennett Park, Blackheath, County of Kent, has applied for LEAVE TO AMEND the SPECIFICATION of the Letters Patent No. 211 of 1888, for "An Improvement in Filters."

Particulars of the proposed Amendments were set forth in the *Illustrated Official Journal* (*Patents*) issued on the 7th of December, 1892.

Any person may give notice (on Form G) at the Patent Office, 25, Southampton Buildings, London, W.C., of the opposition to the Amendment within one calendar month from the date of the said *Journal*.

(Signed) H. READER LACK,
Comptroller General.

Abel and Imray,
Consulting Engineers and Chartered Patent Agents,
28, Southampton Buildings, London, W.C.,
Agents for the Applicant.

NOW READY.

GAS AND WATER CO.'S DIRECTORY, 1892.
Sixteenth Annual Issue, 5s.
GAS-WORKS STATISTICS, 1892.
Fourteenth Annual Issue, 3s. 6d.
WATER-WORKS STATISTICS, 1892.
Twelfth Annual Issue, 2s. 6d.
Handsomely Bound in One Vol., Price 10s.

LONDON: HAZELL, WATSON, & VINEY, Ltd.,
1, CREED LANE, E.C.

ROBERT MARSHALL,
CANNEL COAL MERCHANT,
97, WELLINGTON STREET, GLASGOW.

Prices and Analysis of all the Scotch Cannels on application

AUG. KLÖNNE,
DORTMUND (GERMANY).

REGENERATIVE FURNACES.

Unsurpassed in Efficiency, Economy, Durability, and Easy Working.

NEWBATTLE CANNEL.
Highest Results in Gas, & Excellent Coke.

QUOTATIONS ON APPLICATION TO

THE LOTHIAN COAL COMPANY,
LIMITED,
NEWBATTLE COLLIERIES,
DALKEITH, N.B.

THE SILICA FIRE-BRICK COMPANY,
OUGHTIBRIDGE, near SHEFFIELD
MANUFACTURE
SILICA BLOCKS, BRICKS, AND CEMENT
OF SUPERIOR QUALITY
FOR GAS-FURNACES.
Trade Mark: "SILICA."

These Goods (largely used in Gas, Glass, Iron, and Steel Works) are, on account of their
GREATER DURABILITY,
Strongly recommended where EXCESSIVE HEATS have to be maintained.

TAR.

GAS COMPANIES should not sell at the present low price, but use it for heating their Boilers or Retort-Settings with

WALKER'S PATENT SPRAY BURNER.

Its Heating Value is Twice as Great as Coke.

APPLY TO
C. & W. WALKER,
MIDLAND IRON-WORKS,
DONNINGTON, near NEWPORT, SALOP.

HOLMSIDE GAS COALS.

(Wrought out of Holmside and South Moor Collieries.)

PRESENT production over 3200 tons per working day. Area of coal about 5000 acres, including the largest remaining workable proportion of pure HUTTON SEAM GAS COAL. Analysis of HOLMSIDE GAS COAL *in bulk as shipped* gives 10,500 cubic feet of Gas per ton, of an Illuminating Power of 16½ candles. The Sulphur is about 1 per cent., and the Ash 1¾ per cent. The Coal cokes well, and leaves about 70 per cent. of excellent Coke. To show the progress of HOLMSIDE COALS, it may be mentioned that the quantity carbonized by the London Gas Companies in 1885 was about 200,000 tons; whereas the present consumption of HOLMSIDE COALS in London alone is at the rate of over

400,000 Tons per Annum.

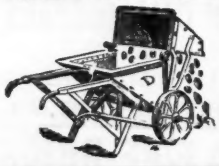
Full particulars on application to

MR. MARK ARCHER,

HOLMSIDE AND SOUTH MOOR OFFICES,

NEWCASTLE-ON-TYNE.

PRICE'S PATENT COKE & COAL BARROW

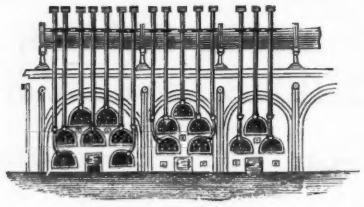


effecting a great saving of time labour, and expense.

For particulars, price, &c., apply to Mr. E. PRICE, Inventor and Patentee, 22, Alwyne Road, Canonbury, LONDON, N.

Prices are Reduced.

DEMPSTERS'



RETORT-SETTINGS,

RETORT-FITTINGS,

ELLAND.

BOLDON GAS COALS.

Worked by THE HARTON COAL CO., LTD.,

Output about 3000 tons per day.

ANALYSIS—

Yield of Gas per ton	10,500	Cubic Feet.
Illuminating Power	16·9	Candles.
Coke	66·7	Coke.
Sulphur	0·86	Sulphur.
Ash	2·04	Ash.

Boldon Gas Coals are supplied under contract to

The Gaslight and Coke Company, South Metropolitan Gas Company, Commercial Gas Company, Imperial Continental Gas Association, European Gas Company, L'Union des Gaz (the Continental Union Gas Company), Danish Gas Company of London, Ipswich Gaslight Company, Devonport Gas Company, Newcastle Gas Company, Sunderland Gas Company, South Shields Gas Company, and to many other Companies at Home and Abroad.

For prices, &c., apply to the

HARTON COAL COMPANY,

LIMITED,

Newcastle-on-Tyne.

W. H. PARKINSON,

FITTER.

THOMAS ILLINGWORTH,

NORTH DEAN CHEMICAL WORKS,

Near HALIFAX,

MANUFACTURER OF SULPHURIC ACID

OF EXTRA QUALITY FOR MAKING

WHITE SULPHATE OF AMMONIA.

TAR, LIQUOR, AND SPENT OXIDE Purchased for Cash against Delivery.

To effect a great saving in

GAS-FURNACES

use our Special Derbyshire GANNISTER BRICKS.

ADDRESS

JAMES WHITE & Co., Limited,

ALBERT WORKS, WIDNES.

TROTTER, HAINES, & CORBETT,

Brettell's Estate

FIRE-CLAY & BRICK WORKS,

STOURBRIDGE.

Manufacturers of GAS-RETORTS, GLASSHOUSE FURNACE & BLAST-FURNACE BRICKS, LUMPS, TILES, and every description of FIRE-BRICKS.

Proprietors of

BEST GLASSHOUSE POT & CRUCIBLE CLAY.

SHIPMENTS PROMPTLY AND CAREFULLY EXECUTED.

UNEQUALLED.

Gas Companies are solicited to try Samples of the

MIRFIELD

BLACK BED GAS COAL.

Prices and Analysis on application.

MIRFIELD (GAS-COAL) COLLIERY COMPY.

RAVENSTHORPE, NEAR DEWSBURY.

MEIKLEJOHN'S PATENT

Improved Slide-Valve Anti-Dip.

Is perfectly reliable in action, and requires no attention. Has all the advantages of the Dip and Anti-Dip, combined.

Is cheap and easily fixed to any form of main.

Will be found the most efficient appliance of the kind yet introduced.

Further particulars and price from

C. MEIKLEJOHN,

GAS-WORKS, RUGBY.

(Late N. MEIKLEJOHN, Longwood.)

JAMES OAKES & Co.,

ALFRETON IRON-WORKS, DERBYSHIRE,

AND

Wenlock Iron Wharf, 21 & 22, Wharf Road, CITY ROAD, LONDON, N.

Manufacture and keep in Stock at their Works (also large stock in London)

PIPES and CONNECTIONS, 1¼ to 48 inches in diameter, and make and erect to order RETORTS, PURIFIERS and TANKS, with or without planed joints, COLUMNS, GIRDERS, SPECIAL CASTINGS, &c., required by Gas Water, Railway, Telegraph Chemical, Colliery, and other Companies.

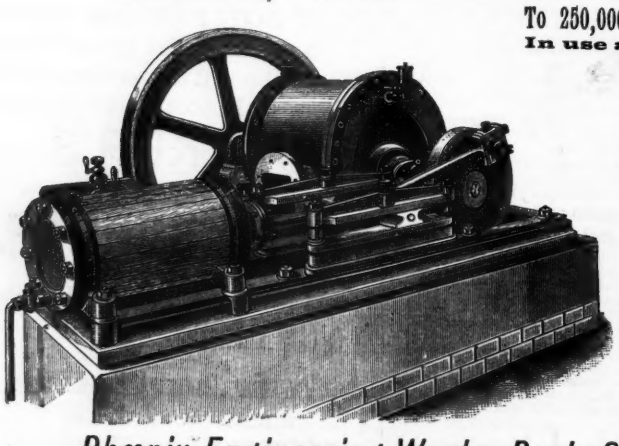
NOTE.—Makers of HORSLEY'S PATENT SYPHONS. These are cast in one piece, without Chaplets; doing away with bolts, nuts, and covers, and rendering leakage impossible.

G. WALLER & CO.'S NEW PATENT GAS EXHAUSTER.

MADE, with FOUR or THREE BLADES,

To 250,000 Cubic Feet per Hour, with or without Engine combined.

In use and on order for over 100 Works, equal to 3,850,000 Cubic Feet per Hour.



SPECIAL ADVANTAGES:

This Four-Blade Exhauster will pass fully 15 per cent. more per revolution than any other Four-Blade Exhauster with the same size cylinder, and with from 15 to 30 per cent. less friction or driving power, and without oscillation.

It will pass fully 50 per cent. more per revolution than any Two-Blade Exhauster, with very little increase in driving power for the increased delivery.

No other Exhauster gives such a steady gauge.

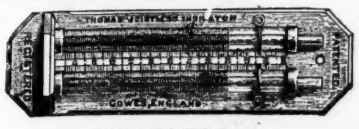
OLDEST MAKERS of BEALE'S EXHAUSTERS for 300 WORKS.

MODEL OF PATENT EXHAUSTER SENT FOR INSPECTION.

Patent Compensating Steam Governors. Special Tar-Pumps.

Phœnix Engineering Works, Park Street, Southwark, London, S.E.

ALEXANDER RUSSELL & CO.,
Cannel and Gas Coal Merchants,
53, WATERLOO STREET,
GLASGOW.



THOMAS'S JOINTLESS GAS GAUGES.
COWES, I.W.
American Patent for Sale.

THOMAS TURTON
AND SONS, LIMITED,
Sheaf & Spring Works,
SHEFFIELD,
MANUFACTURERS OF
FILES OF BEST QUALITY
FOR ENGINEERS.
STEEL OF ALL DESCRIPTIONS.
SCREW STOCKS, TAPS AND DIES,
SPANNERS, RATCHET BRACES, LIFTING JACKS
ANVILS, VICES,
AND ENGINEERS' TOOLS GENERALLY.
London Office:
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CAST-IRON PIPES
FOR GAS AND WATER.
Pipes, One to Six inch Bore, kept in Stock. Also a very large assortment of all sizes of Bends, T-pieces, and Specials ready for despatch on receipt of Order.
VALVES
FOR GAS, WATER, AND STEAM.
TELEGRAMS: "PIPES GLASGOW."
WM. MACLEOD & CO.,
56, ROBERTSON STREET, GLASGOW.

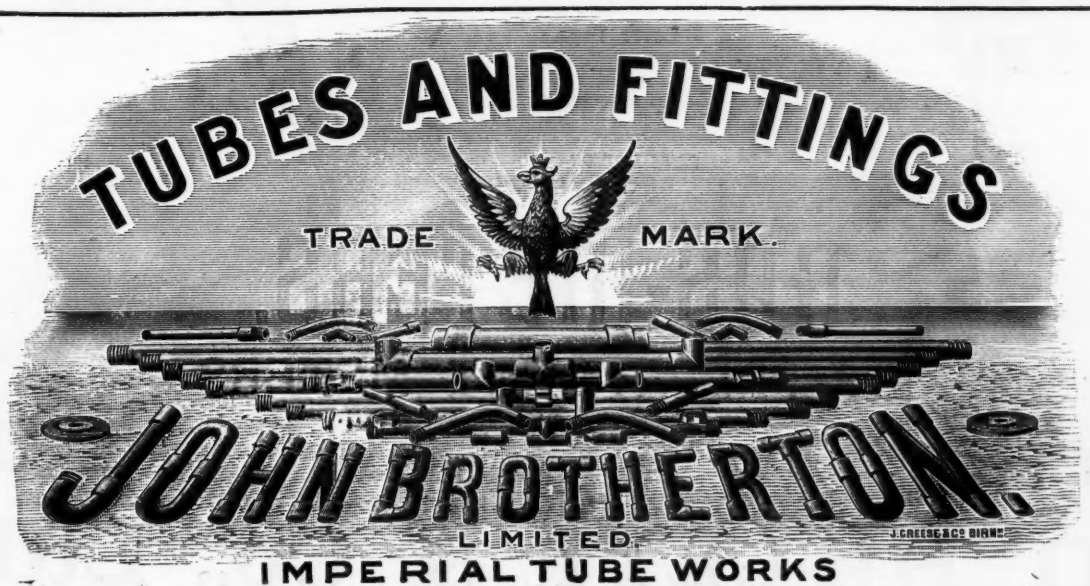
T. B. KITTEL, SHEFFIELD.
CONTRACTS FOR SUPPLIES OF ANY
OF THE PRINCIPAL
ENGLISH & SCOTCH
CANNELS.
REAL SILKSTONE GAS COAL
ANALYSIS AND PRICES ON
APPLICATION.
T. B. KITTEL, SHEFFIELD.

Awarded HIGHEST MEDAL and DIPLOMA
at the Newcastle-on-Tyne Royal Mining
and Industrial Exhibition, 1887,
for
CANNEL & COAL.

TYNE
BOGHEAD
CANNEL.
Yield of Gas per ton . . . . . 13,155 cub. ft.
Illuminating Power . . . . . 38·22 candles.
Coke per ton . . . . . 1,301·88 lbs.
EAST PONTOP
GAS COAL.
Yield of Gas per ton . . . . . 10,500 cub. ft.
Illuminating Power . . . . . 16·3 candles.
Coke . . . . . 70 per cent.
For Prices and complete Analysis, apply to
YOUNG, DANCE, & CO.,
COAL OWNERS, NEWCASTLE-ON-TYNE.
Or E. FOSTER & CO., 21, John St., Adelphi, LONDON, W.C.

BEST
GAS COAL. REAL OLD SILKSTONE GAS COAL,
Address THE STRAFFORD COLLIERIES COMPANY,
Near BARNSLEY, SOUTH YORKSHIRE.

INCLINED RETORTS,
FIRE BRICKS,
LUMPS, TILES,
BLOCKS, &c.
Special Bricks for Intense Heats.
GAS RETORTS.
CASTINGS AND
EVERY REQUISITE
FOR
GAS-WORKS.
MOBBERLEY & PERRY,
Fire-Brick Works, STOURBRIDGE.
☛ Retort Setters sent to any part of the Kingdom.



Gas Lamps and Posts.

Several thousands of these are now in use, giving general satisfaction. They are strongly made, and of best material.

Patent Street Lamps.

NO PUTTY.

Lamplighters' Torches.

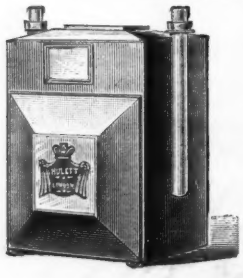
Lever Taps.

Lamp Governors.

PRICE LIST ON APPLICATION.

SPECIAL HIGH-POWER LAMPS.

For Lighting Streets, Refuges, Promenades, &c., where a good light is required. Fitted with Porcelain cone, Copper top and perforation, Wrought-Iron Spray, Lever Tap, Burner and Patent Governor, glazed with Opal top.



GAS-METERS.

PREPAYMENT METERS

(PRICE'S PATENT)

SPECIALLY ADAPTED FOR INCREASING CONSUMPTION AMONG SMALL CONSUMERS. NO RISK OF BAD DEBTS.

D. HULETT & Co., Ltd.,

55 & 56, HIGH HOLBORN, LONDON.

ALEX. C. HUMPHREYS, M.E.
General Superintendent & Chief Engineer,
The United Gas Improvement Company, U.S.A.

A. G. GLASGOW, M.E.,
Late General Inspector,
The United Gas Improvement Company, U.S.A.

HUMPHREYS & GLASGOW,

Contracting Engineers for Water Gas Plant,
9, Victoria Street, London, S.W.

JOSEPH CLIFF & SONS,

INCORPORATED IN
THE LEEDS FIRE-CLAY COMPANY, Ltd.,
WORTLEY, LEEDS.

LONDON Offices & Depôts:
Baltic Wharf, Waterloo Bridge.
WHARVES NOS. 2 & 4, INSIDE G.N. GOODS YARD, KING'S CROSS, N.
LIVERPOOL:
16, Lightbody Street.
LEEDS:
Queen Street.

MACHINE-MADE RETORTS

Have been made in large quantities for the last twelve years; and during the whole of that time, have been in regular use at most of the largest Gas-Works in the Kingdom. They possess the excellent quality of remaining as near stationary as possible under the varying conditions of their work—a quality which will be appreciated by all Gas Engineers and Managers. The generally expressed opinion is that these Retorts are the very best that are made.

RETORTS CAREFULLY PACKED FOR EXPORT.
Fire-Bricks, Lumps, Tiles, &c., &c., of every description suitable for Gas-Works.

ESTABLISHED MORE THAN A QUARTER OF A CENTURY

WORKS
HUNSLET.
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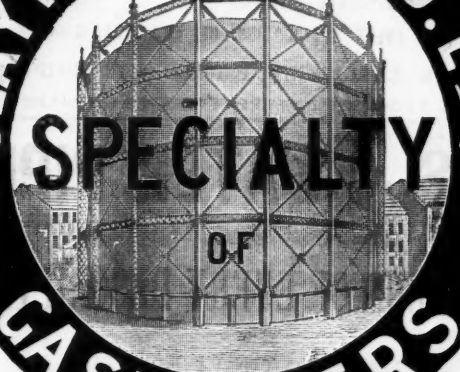
LONDON OFFICE:
60, QUEEN VICTORIA STREET
E.C.

CLAYTON SON & CO. LTD.

MAKE A



SPECIALTY OF GASHOLDERS

AND MAKERS OF
GAS PLANT OF EVERY DESCRIPTION.

REGD. TELEGRAPHIC ADDRESS:
"GAS LEEDS"

Wrought-Iron

And Fittings and Accessories.

LAMBERT BROS., WALSALL,

MANUFACTURERS OF
WROUGHT-IRON TUBES & FITTINGS for GAS, WATER, & STEAM,
BRASS GAS-FITTINGS, GAS-VALVES, STEAM & WATER VALVES, TOOLS, &c., AND OF
WARNER'S PATENT MARKET GAS STAND-PIPE.
LONDON: LAMBETH BRASS & IRON CO., Short Street, LAMBETH.

JOHN BROWN & CO., LTD., SHEFFIELD,

Proprietors of
ALDWARKE MAIN CAR HOUSE & ROTHERHAM MAIN COLLIERIES, NEAR ROTHERHAM.
ALDWARKE MAIN GAS COAL

Analysis: 12,600 feet of 19-candle gas per ton.
Weight of illuminating power in pounds of sperm, 820·80. Very free from impurities.
Telegrams: "ATLAS SHEFFIELD."

IMPORTANT TO ENGINEERS AND GAS COMPANIES.

A NEW CARBURETTOR FOR ENRICHING GAS IN BULK.

The Carburettors have been doing practical work for the past two years; in many cases doing all the enrichment without the use of Cannel or other rich Coals. The South Metropolitan Gas Company have these Enrichers at all their Stations. The Gaslight and Coke Company have had them in use at some of their principal Works for two years past; and several more are now being fixed at their other Stations. The Carburettors are also in use at several Suburban and Provincial Gas Companies' Works.

FOR PRICES AND FULL PARTICULARS, APPLY TO

THE GAS LIGHTING IMPROVEMENT COMPANY, LIMITED,

(FRANK W. CLARK, Engineer and Manager)

18, DEVONSHIRE STREET, BISHOPSGATE, LONDON.

CARLESS, CAPEL, & LEONARD,

HOPE CHEMICAL WORKS, HACKNEY WICK, LONDON, N.E.,

NAPHTHA AND GASOLINE DISTILLERS AND PETROLEUM IMPORTERS,

Specially prepare GASOLINE, specific gravity ·650; CARBURINE, specific gravity ·680; or any other Hydrocarbon best adapted for Carburetting Gas.

Prices and Samples may be had upon application.

JOHN HALL & CO.,

STOURBRIDGE,

MANUFACTURERS OF FIRE-BRICKS, LUMPS, TILES,

AND EVERY DESCRIPTION OF FIRE-CLAY GOODS.

RETORTS CAREFULLY PACKED FOR SHIPMENT.

A STOCK OF DIFFERENT SHAPES ON HAND.

GAS AND WATER PIPES

AND

CASTINGS OF EVERY DESCRIPTION.

MANUFACTURED BY THE

CLAY CROSS COMPANY,

CHESTERFIELD.

TRADE	TELEGRAMS:	LONDON AGENTS:
C X C	"JACKSON"	BECK & Co.,
MARK.	CLAY CROSS.	130, ST. SUFFOLK ST., S.E.

GODDARD, MASSEY, & WARNER'S

IMPROVED

Sulphate of Ammonia Apparatus.

The most successful and approved Apparatus known up to the present time.

FOR REFERENCES, PARTICULARS, TESTIMONIALS, AND PRICE APPLY TO

GODDARD, MASSEY, & WARNER,

ENGINEERS,

NOTTINGHAM.

The Apparatus has been supplied to the following Firms–

BURT BOULTON, & HAYWOOD, SILVERTOWN, and ELING.
CHANCE BROTHERS, OLDBURY (Four Apparatus).
RUNCORN SOAP & ALKALI CO., Limited, RUNCORN.
NETHAM CHEMICAL CO., Limited, BRISTOL.
ANIMAL CHARCOAL CO., Limited, SHADWELL.
WM. BUTLER & CO., BRISTOL.
KEMPSON & CO., Pye Bridge.

And to the following Gas Companies and Corporations–

ILKESTON.	BURY.	CHORLEY.
WIDNES.	BRIGHOUSE.	WHITEHAVEN.
HALIFAX.	MARKET HARBRO'.	CHESTER.
ALTRINCHAM.	PRESCOT.	SOUTH SHIELDS.
DENTON.	SOWERBY BRIDGE.	LEEK.
ST. ALBANS.	LEICESTER.	IPSWICH.
DUKINFIELD.	DARWEN.	BOURNEMOUTH.
NORTHWICH.	NELSON.	SALFORD.
HUDDERSFIELD.	ORMSKIRK.	LUTON.
		HAMPTON COURT.

JONAS DRAKE & SON,

TELEGRAPHIC ADDRESS:
"DRAKESON, HALIFAX."

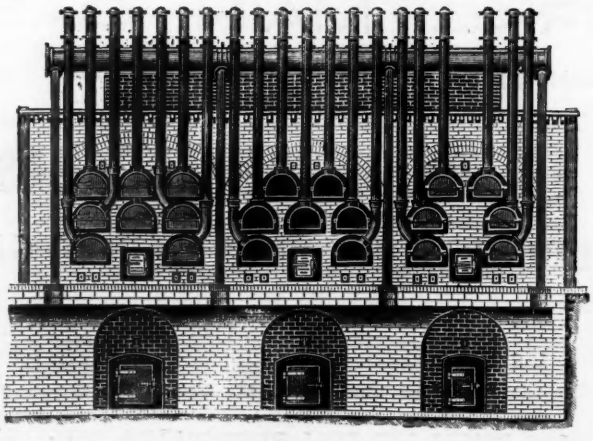
TELEPHONE No. 43.
HALIFAX EXCHANGE.

GAS ENGINEERS,

CONTRACTORS,

IRONFOUNDERS,

BUILDERS AND ERECTORS OF EVERY DESCRIPTION OF OVENS, BENCHES, KILNS, FURNACES, &c.



RETORT SETTERS,

FURNACE BUILDERS

ETC., ETC.

REGENERATOR AND GENERATOR FURNACES ON DRAKE'S, FRITH'S, SIEMENS'S, KLONNE'S, HASSE'S, VALON'S, SOMERVILLE'S, PONSARD'S and other Principles.

INCLINED RETORTS

GASEOUS FIRING A SPECIALTY.

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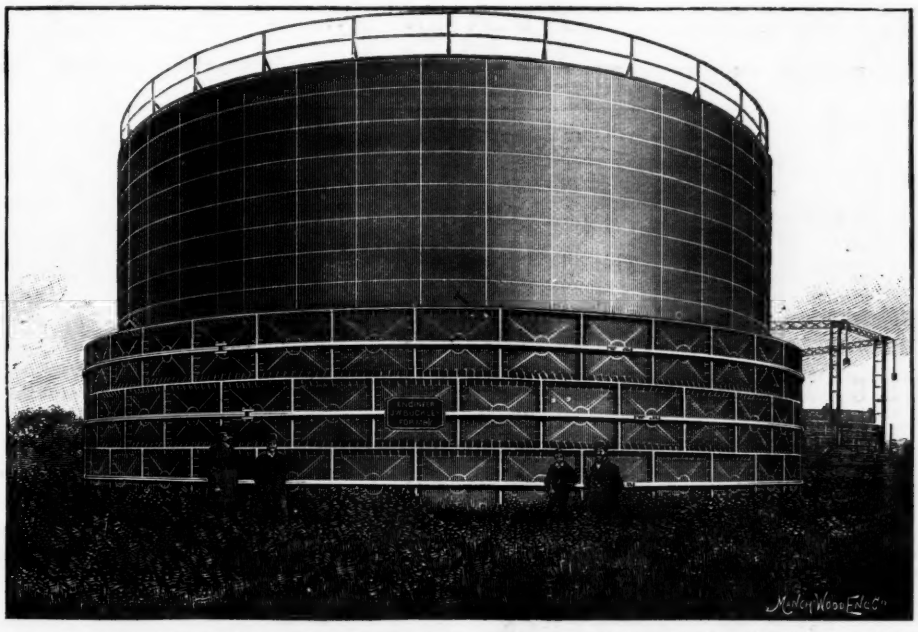

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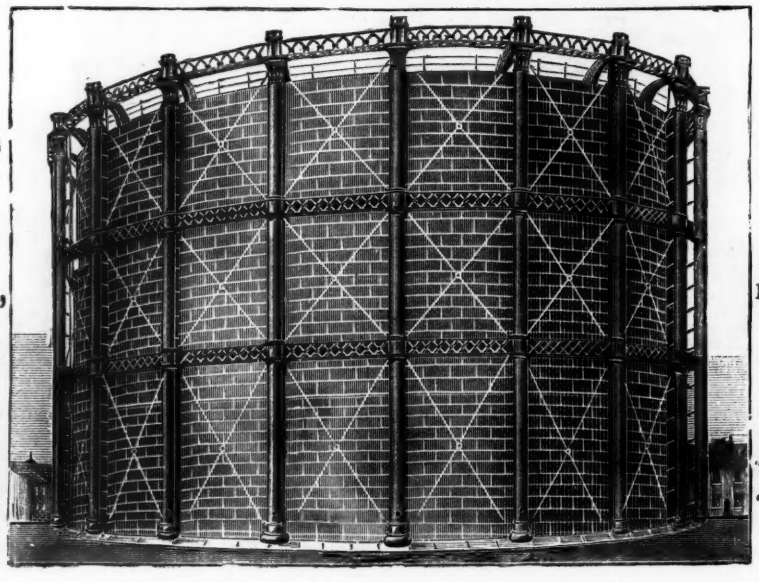

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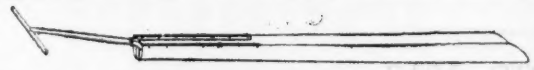

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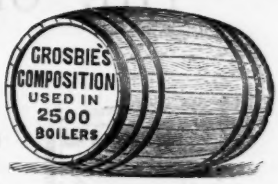

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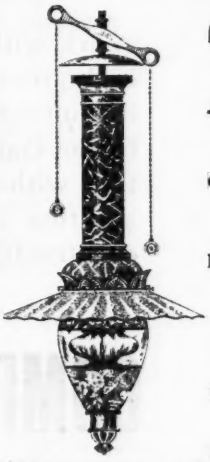

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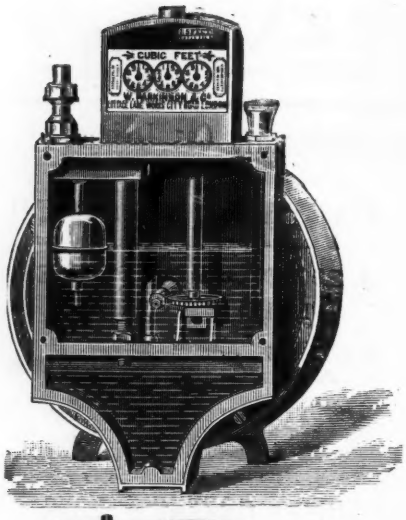

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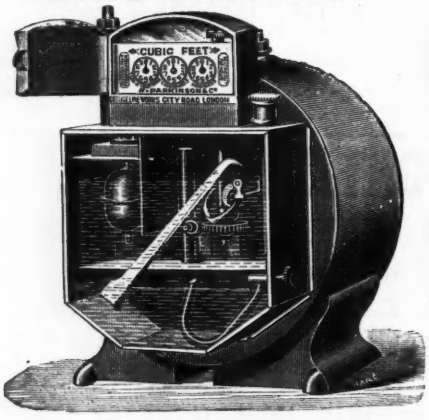

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